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ELECTRIC ELEVATORS.

The only parallel to the marvelously rapid evolution of the electric street railway is furnished by the growth of the electric elevator from the crude forms of ten years ago to the perfected mechanisms of to-day. Both of these developments, so remarkable for their completeness and perfection, are due to the genius and industry of American engineers, and should excuse no small amount of satisfaction and self-congratulation on their part.

The advance of engineering in this country has always kept pace with the growth of new conditions. The changed aspects of our largest cities due to the erection in recent years of very high buildings has become marked. The increase of population in these centres and the enhanced values of land necessitated an upward extension of buildings, and this in turn necessitated the perfection of elevator systems.

In the earlier reconstruction of our congested centres of business the hydraulic elevator played an important part. With the perfection of steel structural material and the invention of a new method in architectural construction, almost an indefinite increase in the height of buildings was possible, and it soon became apparent that more rapid, certain and efficient means of vertical transit were necessary. The demands for improved facilities in this kind of transportation began to be of the same nature as that for better methods of horizontal transit—and satisfaction for both was found through the agency of electricity.

One of the most convincing demonstrations of the perfection of control and the ease of application of electric power is found in those elevator installations where power furnished by an engine undergoes a double transformation into electricity and back again to mechanical effort in order to permit its safe and convenient use.

There can be no doubt that the ease with which elevators can be installed and the modern perfection and certainty of central station current supply systems which, used in conjunction with these elevators, do away with the necessity for a power generating plant on the premises, will make this branch of the industrial application of electricity a highly important one. When it is considered that in New York City alone there are over five thousand power elevators, it will be seen that the field is very large. There seems to be no indication of decrease in the rate of growth of our cities, and this indicates that the field for such construction will continually increase in proportion to the necessities of urban congestion.

THE HELIOGRAPH IN WAR.

However valuable and indispensable the telegraph may be in times of war, it cannot always be depended upon on such occasions. A variety of causes are likely to occur at any moment that preclude the use of this important means of communication, and it is at such times that the necessity arises for a reliable and untamperable method of conveying intelligence. It may seem rather strange in these days of scientific progress that it was recently necessary to resort to one of the earliest methods of signaling at a distance in order to convey intelligence relating to military operations. This occurred in Crete, the scene of the present "unpleasantness" between Turkey and Greece. As is well known, the "powers" are the professed masters of the situation there, and nothing can be done without the sanction of the admirals of the fleets representing the

powers. Colonel Vassos, the commander of the Greek troops in Crete, has been prohibited from the use of the telegraph cable for the transmission of dispatches to his Government, but this interdiction has not deprived the resourceful commander of means of forwarding his messages. The colonel has established heliographic communication with Grecian territory, and although this is not so rapid as the telegraph, yet it no doubt fully meets the requirements under the circumstances. The successful operation of the system is greatly favored in this instance by the proximity of the island of Crete to other islands of the Grecian Archipelago and the mainland. On a clear day the mountains are plainly discernible from the coast of Greece, but Colonel Vassos, according to a dispatch from Athens, evidently does not signal directly with the mother land. He flashes the signals first to the island of Anticythera, twenty miles distant, thence they are repeated to the island of Cythera, twenty miles further on, and from there to the mainland of Greece, ten miles away. Once in Grecian territory, the dispatches are transferred to the wires and forwarded to Athens. Although the heliograph and other visual signaling systems are classed ordinarily as antiquated methods, exigencies sometimes arise where their usefulness becomes of the first order. The practical utility of the signal corps in modern times cannot be questioned after this present demonstration, in which its value has been most positively emphasized.

HORSELESS CARRIAGES.

It seems now that the electric automobile vehicle has reached that point of perfection which marks the line of demarcation between experiment and commercial practicability. Within a few weeks electric hansoms have been put in operation in this city, in competition with horse-vehicles, for public service, and have achieved a great and immediate popularity.

There has been a keen competition between two types of motive power for the propulsion of these vehicles, and the differences of opinion on the subject have been fruitful sources of controversy. The gasoline engine, with its high output for unit weight and great economy of operation, seems to have established its right to be considered the proper form of prime mover for vehicles designed for long-distance travel or rough-and-ready work on ordinary roads. In certain contests, notably the Paris-Marseilles race last Summer, it has been clearly demonstrated that automobiles of this type can safely traverse considerable stretches of country, taking the chances of bad roads, mud, heavy grades and the accidents and incidents of cross-country travel.

In cities, however, the problems to be solved are of another sort. A vehicle to safely manoeuvre in a crowded street must possess the utmost facility of control, be capable of instantly starting and suddenly stopping, and should be noiseless and inoffensive in other ways. The ideal conditions under these circumstances seem to be much more nearly fulfilled by the electric carriage. The gasoline motor requires to be started by hand or other extraneous power, and must be kept constantly running so long as the vehicle is in use. A mechanical clutch of greater or less complexity is required to gear the motor to the running parts of the carriage—its complexity depending upon the number of speed changes possessed by the vehicle. The noise, vibration, and, above all, the odor, accompanying the operation of such an engine seem to militate against its use on vehicles designed for urban purposes.

On the other hand, the electric motor, with its almost ideal simplicity of control, its instant readiness and responsiveness, the ease with which it starts under load, and the simplicity and directness of the gearing by which it may communicate motion to the wheels of the carriage, seems to meet the requirements of the case most perfectly. The smoothness of the rotary motion of the electrical mechanism as contrasted with the jarring reciprocations of the gasoline engine, and the entire absence of noise and odor attending its operation are further points in its favor. The sole elements of difficulty are the weight of the necessary accumulators and the limited range of operations possessed by a carriage which must return after a few miles' run to the charging point.

Even allowing that these difficulties cannot be overcome, it seems that the electric vehicle is admirably suited for those uses to which it is most likely to be put in the immediate future. The field for self-propelling vehicles is, beyond all doubt, in urban uses—omnibuses, delivery wagons, ambulances, pleasure carriages, and the like. Such vehicles are not likely to make long runs or to go far from their charging stations, and in most cases would have a regular stated route of travel, returning periodically to their points of charge renewal.

There is not the least reason, however, to assume that the accumulator will not undergo great and marked changes and improvements. In general, whenever there is a demand for a specific improvement or invention, it soon makes its appearance. There has already been a great increase in output and capacity in accumulators, and it is certain that much room for improvement remains. The feasibility of electric automobiles for many purposes largely hinges upon the future development of portable electrical supply mechanisms. It can hardly be questioned that the advent of this new form of traction is destined to work great changes in municipal conditions in the directness of increased cleanliness and healthfulness, and the suppression of much needless noise, while it is a most potential argument for better street pavements.

ELECTRICITY ON STEAM RAILROADS.

For several years rumors have been current that the Illinois Central Railroad Company has had in contemplation the substitution of electricity for steam in moving suburban trains in the vicinity of Chicago. It is now asserted that the directors have come to the conclusion that it will be expedient to work that part of the system by electricity, and that they have stated a preference for the third-rail method of conduction.

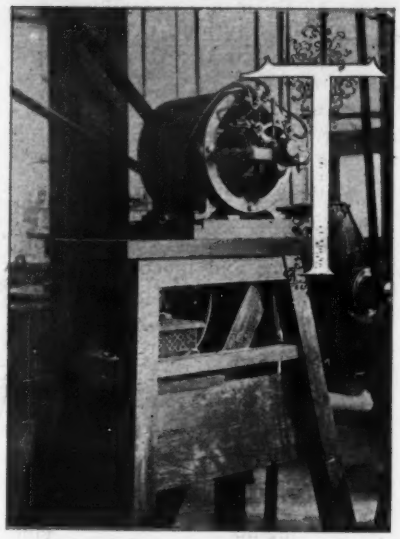
There seems to be a gradual but rapidly increasing movement on the part of the more prominent steam railroads, and especially those engaged in heavy suburban traffic, to give electricity an opportunity to demonstrate its capacity for the purpose of handling such trains. The experiments of the New York, New Haven & Hartford Railroad at Nantasket Beach, near Boston, have been so successful that upon the completion of the new union station in the southern part of the city of Boston, it is likely that all suburban trains running into it will be operated electrically. The Washington, Alexandria & Mount Vernon Railway Company has already shown the feasibility and economy of operating suburban trains on the same tracks with through steam trains.

The change from steam to electricity for this purpose seems now to be a question of finance only. Several installations have demonstrated the fact that electric power can be relied upon for the operation of comparatively light trains making frequent stops and running at high speeds between stations. There is no longer any question as to the permanence and strength of electrical apparatus; the only consideration is one of cost.

The Roosevelt Telephone Patent.

We are informed that Judge Crosscup, in the United States Court at Chicago, on April 5, decided the Roosevelt patent case in favor of the Western Telephone Construction Co. and against the Western Electric Co. The bill was dismissed for want of equity.

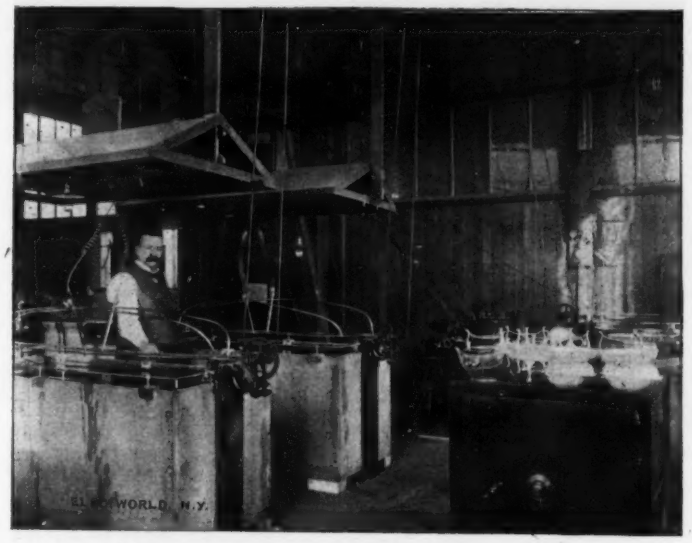
Electric Power Plant of the Tiffany Factory at Forest Hill, N. J.



THE economical operation of machinery in manufacturing establishments is an extremely important problem in the manufacture of any particular commodity. It may even be said that the wonderful development of our industrial interests is largely based upon the facility and economy of power operation of the various machinery necessary. The operation of the machinery of an extremely large manufactory by means of one centralized power unit, through the medium of a complicated and power-losing system of belts, ropes, gears, etc., seems to be more or less a method which must eventually give way to the more modern and economical individual motor method.

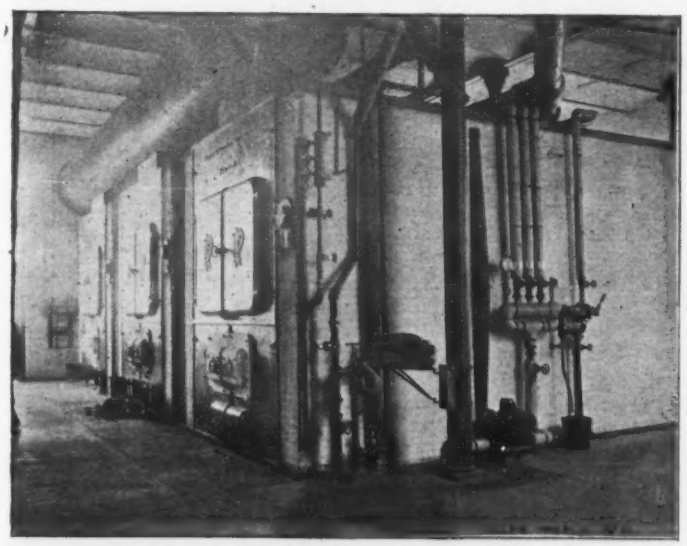
A recent installation of this type, which is undoubtedly of interest not only from the fact that it is of fairly large size, but because the operators of the factory are very conservative and are extremely careful in adopting any new methods without being first assured of their absolutely satisfactory operation. This is the plant which has recently been installed at the Tiffany factory at Forest Hill, on the outskirts of Newark, N. J., and on the line of the Greenwood Lake division of the Erie Railroad. This factory has but recently been completed, and is a structure of very elegant proportions and finish. A total floor space of almost 100,500 square feet is provided, and all the solid silver and silver-plated ware manufactured by the world-renowned firm of Tiffany & Co., is produced here. Lathes, planers, polishing and grinding machines, punches, rolling machines and innumerable others utilized in the evolution of every possible type of useful and ornamental silver and plated ware can be found at this establishment. The factory is in the form of a large hollow square, with several centrally located courts, and occupies a space of 275x275 feet. The electric plant was installed by the General Electric Company.

The electric power transmission is in the form of various motors, which are distributed throughout the establishment, driving sections of belting and shafting, to which the machines are connected. The engine and boiler rooms, including the electric generating apparatus, are located in a separate L, extending from one side of the main building. Coal is taken from the cars on a short spur passing between the engine and boiler rooms by means of a Hunt hoisting system, and it is stored in a large brick storage bin, adjoining the boiler room. This bin is provided with an inclined floor, so that the coal continuously feeds to the three chutes. The engine room proper is equipped with a large 250-hp Hewes & Phillips Corliss engine, operating at 90 revolutions per minute, which is belted to a jack-shaft, operating at 230 revolutions per minute, by a belt 28 inches wide. The 200-kw General Electric multipolar generators, operating at 250 volts, at 750 rpm, are belted to the jack-shaft. The engine room also contains an air-compressor for the Pohle air lift pump, a Worthington house service pump, a Webster feed-water heating system, and an auxiliary 50-hp Ball & Wood compound engine, which is to be used for light loads, instead of the Corliss engine.

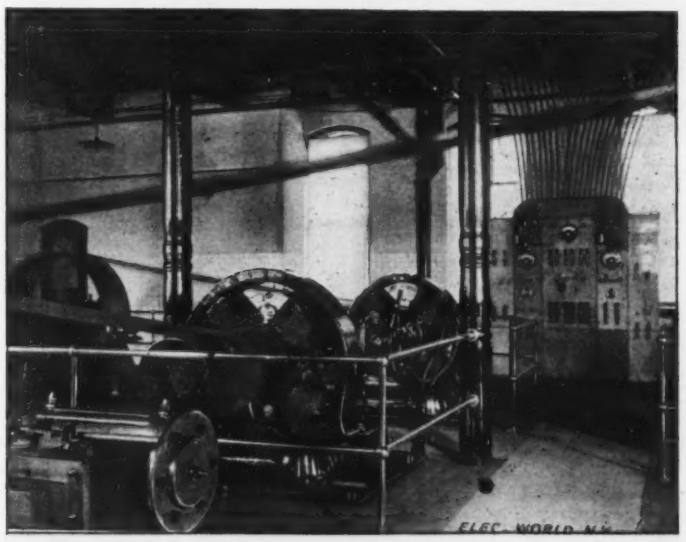


DYNAMO ROOM AND SWITCHBOARD.

The boilers are of the ordinary horizontal tubular type, and are each separately set in very elegantly finished brick walls. The water supply, both for boilers and other purposes, throughout the building, is very complete. The city supply may be called upon, a large cistern under one of the courts collects all the rain water from the surrounding watersheds, and water from an artesian well may be used. A large storage tank, capable of holding 23,000 gallons, is located on one of the large towers forming the ends of the building, and water is pumped to this tank by means of a house pump from the well or cistern. The water from the artesian well is forced up by a Pohle air lift pump and air-compressor to the engine room and thence to the tank, by means of the house service pump. The supply for the boilers comes through the Webster heater system and passes through a single supply pipe to the side of the end boiler, where it divides into three separate supplies, one to each boiler. A single injector is supplied at this point, which may be used to supply any of the three boilers in case of necessity.



THE BOILERS.



ELECTROPLATING ROOM.

The current from the dynamos is brought to a switchboard located at the house side of the engine room. This switchboard is of marbleized slate with five panels, one central panel being provided for the main building, having on each side a dynamo panel, each of which contains the controlling apparatus for its respective machine, and the two extreme outer panels supply two wings of the main structure. The switchboard was built by the General Electric Company, and is equipped with very quick-break single-pole switches, each circuit being supplied with two of these switches, which are singly operated. Carpenter enamel rheostats and Weston ammeters and voltmeters are used.

The dynamos are compounded, the equalizing connection being made direct from the machine, and is permanent without any switching devices. The main central panel supplies five lighting circuits and one power circuit, while each of the two outer feeder panels supplies one lighting and one power circuit. The wiring from the switchboard is all on porcelain insulators, triple-braided, weather-proof wire being used throughout.

The motor equipment includes about 275-hp of motors, varying from 3 to 50 horse-power, and divided into about eighteen units. These are all of the General Electric type, those below 8 horse-power being bipolar, while those above are multipolar. The motors operate at about the following speeds: The 3 horse-power at 1800, 8 horse-power at 1350, 5 horse-power at 1700, 30 horse-power at 950, 20 horse-power at 1050 and 50 horse-power at 550.

Many of these motors are mounted upon stands with the starting boxes fastened to the stand and readily accessible. All of the starting boxes are of the latest General Electric type, and are equipped with automatic open-circuit releases.

There are about 1200 16-cp and about 300 32-cp incandescent lamps distributed through the factory, which are supplied on the two-wire system from the switchboard. The lamps are all operated at 220 volts and are supplied from entirely separate circuits. No switches are used in any part of the building, and most of the lighting throughout the shop is by means of ordinary drop cords and key sockets. The motors are supplied at the same voltage. All wiring is figured for a maximum drop of 3 per cent.

The plating room of the factory is very interesting, and the extremely excellent work which can be done in this direction with the most peculiar forms of dynamo-electric machines is particularly notable. The plating room is equipped with three large tanks, which are equipped with mechanically shifting supports for the articles to be plated, current being supplied by two Mather plating machines. It is also interesting to note the extremely large consumption of silver in this establishment, which amounts to 200,000 ounces per year. The precautions which are taken to lose as little as possible of this quantity in handling and during the various stages of the manufacturing processes have even made it necessary to collect and filter the water with which the various articles are washed during their manufacture.

The Fourth Anaual Reception of The New York Academy of Sciences.

On the evening of April 5 and the afternoon and evening of April 6 the New York Academy of Sciences held its fourth annual reception and exhibit at the Museum of Natural History, at Seventy-sixth Street and Central Park West. The various exhibits displayed in the large hall of the Museum included the latest advancements in the various branches of science. Among the various sections were those on Anatomy, Astronomy, Botany, Chemistry, Electricity, Icthyology and Archaeology, Experimental Psychology, Geology, Mineralogy, Teleontology, Photography, Physics, Physiology and Zoology. Of particular interest to the electrical fraternity were the exhibits devoted to chemistry, electricity and physics. The electrical exhibits were shown on Monday evening and Tuesday afternoon, April 5 and 6, and were in charge of Mr. George F. Sever, of Columbia University.

The vast throng of visitors well attested the great popular interest in scientific matters which pervades the metropolis. President Stevenson, in his address, commented on the great endowments which science had received during the year and is still receiving in New York City, remarking that it was wholly unprecedented by any record ever before made by any municipality in the world.

Mr. Morris K. Jesup, President of the Museum, also made an interesting address.

The electrical exhibits were probably not so numerous as last year, but several of them were extremely interesting. They were not confined to the section of electricity, quite a number of them being placed in the sections of physics, chemistry and photography.

Among them were the following in the Electrical Section:

Some of the most recent developments in Röntgen ray apparatus, including a Thompson 14-inch spark inductorium, Crookes tubes and fluoroscopes, as built by the General Electric Company, were exhibited by Mr. W. H. Meadowcroft.

An extremely interesting exhibit was made by Messrs. Clark and McMillen, senior students in electrical engineering at Columbia University, of apparatus for obtaining the maximum value of the direct current in any circuit and the time elapsing between the make and break of the circuit. This apparatus consisted in connecting across a line controlled by a circuit-breaker a shunt consisting of a chemically prepared disc, rapidly rotating and in contact with a metallic pencil, the current passing through the pencil to the chemically prepared disc. The current controlled by the circuit-breaker is gradually increased until the limit is reached. The amount of current at the moment the circuit-breaker opens is measured by means of a ballistic galvanometer connected to the secondary of a small transformer whose primary is in series with the line. As long as the circuit is closed through the breaker, the action of the current on the chemically prepared paper leaves a line which is discontinued as soon as the circuit is ruptured by the breaker. By knowing the speed of the disc, the time necessary for the circuit-breaker to act after receiving its maximum current can readily be calculated.

Mr. M. O'Connor exhibited various Crookes tubes for making Röntgen ray photographs, as well as an induction coil with a 20-inch spark.

The latest type of Fort Wayne A. C. single-phase motor was shown. Some porcelain insulators, such as used in the Niagara-Buffalo transmission line, carrying a pressure of 10,000 volts, were exhibited by the Electrical Engineering Department of Columbia University. Prof. M. I. Pupin showed a large induction coil and circuit-breaker for the generation of Röntgen rays.

Various special Crookes tubes and a peculiarly constructed oil coil for Röntgen ray work were shown by Mr. Max Osterberg, who also exhibited a very ingenious igniter for gas engines, which dispensed with vibratory contacts such as are ordinarily used with induction coil sparking devices for this purpose.

Dr. R. Ogden Doremus exhibited one of the two original Henry induction coils.

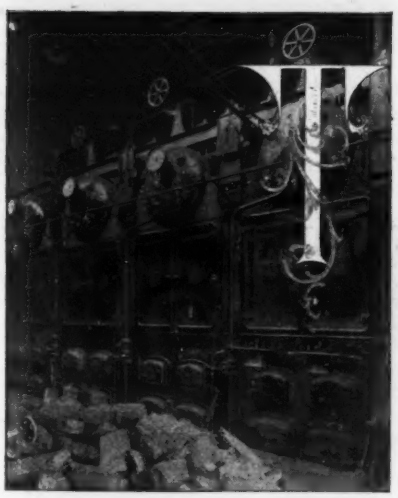
In the section of chemistry was quite an array of electrical furnaces, one of which was that used by Moissan in his lecture before the Academy on Oct. 27 last, with which he distilled silicon, using 300 amperes. A more recent electrical furnace, shown by the New York College of Physicians and Surgeons, secures the same result with only 20 amperes. The same exhibitors also show a furnace containing a crucible in which carbides are made, and quite an array of carbides of different metals was exhibited. The subsequent dissociation of these carbides by water gives very interesting and very varied results. Of course acetylene is now the most widely known, this being produced by the action of water on calcium carbide. A remarkable reaction takes place between aluminum carbide and hot water (cold water does not affect it). In this case methane is given off..

In the physics section Prof. O. N. Rood exhibited his now classical set of photographs demonstrating the regular reflection of the X-rays; the one subject in which other observers have really added an important supplement of Röntgen's own researches. C. C. Trowbridge showed two new forms of fluoroscopes, adapted to original research. H. C. Parker exhibited a set of low-resistance shunts for electrical work.

Of course the last word was said and the latest apparatus shown in the matter of X-rays, the address of the closing evening being made by Dr. Nicola Tesla, who demonstrated his subject by a fine array of improved apparatus, in which a few feet of wire were made as efficient as miles under old systems. Dr. Tesla spoke with considerable feeling of experiments made by him several years ago, in which he obtained results which he may trace with confidence to the X-rays; but the pressure of other business, and then the destruction of his laboratory by fire, cut short investigations which might have opened the door to this new realm on the threshold of which he already stood, and might have enabled him, perhaps, to have made this great discovery. He stated further that he had very recently made an important extension of this new science by obtaining the X-rays direct from the arc light, and without the high vacua heretofore required.

Electric Lighting in Norwich, England.

BY HERBERT C. GUNTON AND HAROLD LOMAS.



THE electric light plant at Norwich is situated on the bank of the River Wensum, about 300 yards from the city, and is thus conveniently located near the centre of distribution. The Norwich Electricity Company, Limited, which owns it, commenced operations in 1892, when current was first supplied to consumers. The system in use is a continuous-current, three-wire, low-tension installation, in conjunction with a battery of accumulators at the central station and one accumulator sub-station. The current is supplied at 220 and 110 volts.

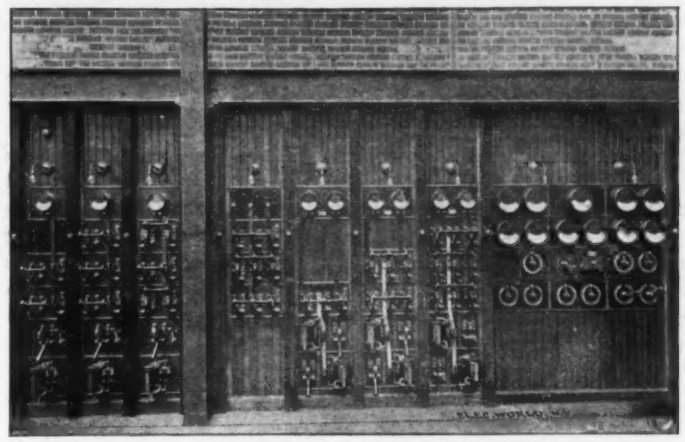
The plant consists of five Babcock & Wilcox boilers, of 140 nominal horse-power each, supplied with a Babcock economizer, and working at a pressure of about 160 pounds. The exhaust steam of the boiler pumps is utilized for feed-water heating in a small tank, from which the water passes through the economizer on its way to the boilers. The feed pumps are four in number, three of them of the duplex pattern, supplied by Messrs. Mumford, of Colchester, and the fourth a compound single Blake & Knowles pump. All the bends of the steam pipe are of copper, the branches to the engines being wrought iron. Körting condensers are used, having a capacity of 23 inches of vacuum at full load, but should the plant be required to operate non-condensing, the exhaust steam can be turned into the exhaust main, which is tapped into a brick culvert, used to carry the condensing and condensed water, as well as all drainage, to the river. The condensation water is pumped

THE DYNAMO ROOM.

into a large tank, some 24 feet above the river, by four centrifugal pumps, directly coupled to electric motors.

The engine room plant includes eight direct-connected units, three of which consist of Willans engines, each direct-connected to two Norwich four-pole dynamos, of 280 kw, at 110 volts. Three other sets consist of Willans engines, each direct-connected to a single two-pole Norwich dynamo, of 81-kw capacity, at 220 volts, and two larger sets are each composed of a similar engine, driving a similar 220-volt dynamo, of 125-kw capacity. The sets of engines direct-coupled to two dynamos each are used for balancing the mains and for the day loads. A very high efficiency is maintained in these sets, the 125-kw outfit giving a combined efficiency of 81.4 per cent. and using 15 pounds of water per indicated horse-power hour.

The battery plant of the station, consisting of 120 seventeen-plate Crompton-Howell cells, has a capacity of about 300 ampere hours and supplies current for the light loads when the engines are not running, in conjunction with the sub-station battery. The charging is done by means of two continuous-current transformers, each having two windings on one armature. The connections are so ar-



THE MAIN SWITCH-BOARD.

ranged that the primaries take current from the mains either at 110 or 220 volts, through regulating resistances, and the secondaries are placed in series with the 110-volt mains.

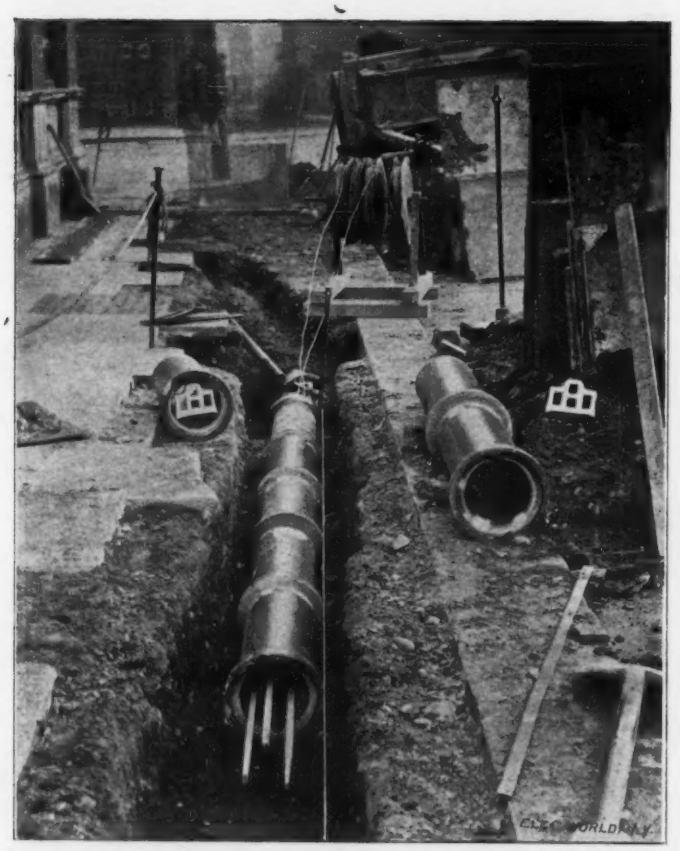
The switchboard is very clearly shown in the illustration. On the right are the field rheostats and dynamo voltmeters, and also three pairs of voltmeters, connected to pressure wires which radiate to various points of the distributing network. The arrangement of the rest of the board is the usual panel for each feeder. Near the centre of the switchboard is a panel for the accumulators only. The accumulator switchboard proper, shown in another illustration, contains the necessary instruments and meters for the charge and discharge of the cells. The batteries on each side of the three-wire system can be charged independently, the board being fitted with double-pole switches and single-pole switches for the transformer primary, field regulating rheostats, voltmeter, ammeter and wattmeter, and a charge and discharge two-way switch, as well as a cell regulator switch.

MOTOR-GENERATORS FOR CHARGING ACCUMULATORS.

The method of distribution in use is very different from the usual engineering practice in America. It is entirely underground, all mains and feeders being of bare copper, except the smallest distributing mains for the houses. About nine miles of conduit have

been installed, containing over 70 tons of copper, and during the five years of its operation no serious trouble has arisen. Except for the first 2000 yards, which was originally put down in concrete culverts, designed by Prof. Robinson, the whole of the mains have been laid in conduits according to a system designed by Mr. Scott, of Laurence, Scott & Co., who installed the plant. By means of this system the copper conductor, in the form of a strip or ribbon, can be drawn in after the conduit is laid, and additions can be made as required. The conduits consist of 6-inch and 9-inch ordinary earthenware drain pipes, joined with cement. Porcelain insulators are fixed in this pipe every six feet, their form being very clearly shown in the accompanying illustrations. These are provided with square holes, through which the copper strip is threaded. The 6-inch pipe carries three conductors, and is used for distributing mains only. The 9-inch pipe carries, in addition, two conductors for feeding. Manholes are built wherever there is a change of direction in the pipe, and on straight parts at distances of 80 to 100 yards. When the pipes are laid, a No. 14 galvanized iron wire is threaded through the insulator holes, and subsequently used to draw through a strong wire rope, by means of which the copper strips are afterward pulled in. When the strips are in place they are thoroughly stretched by a screw jack and clamped up against strong insulators at the mouth of the pipe, a piece of sheet indiarubber being used between the clamping piece of the insulator and the copper conductor. This is done at each manhole, where the different lengths are subsequently connected up. A 2 or 3 inch pipe, laid along the side of the conduit, carries the pressure wire back to the station. After the pipes are in place, three inches of cement concrete are thoroughly tamped around them.

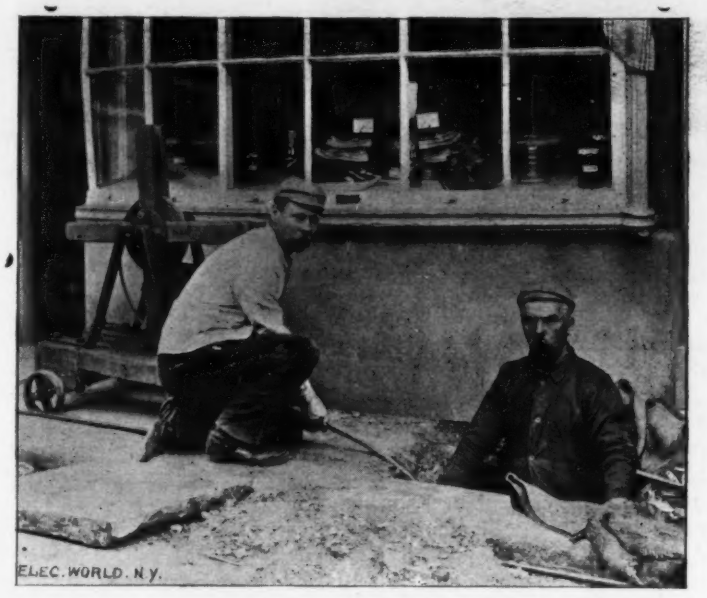
A little over a mile from the central station, in a residence district, is installed the sub-station, which serves to maintain the pressure in this neighborhood, and, also, in connection with the central station accumulators, to supply current back through the mains to the city when the engines are not in operation. The sub-station accumulators are charged during the day from the central station through a feeder, in conjunction with direct-current transformers, similar to those at the station itself. This feeder is connected to the distributing mains at a point about half-way between the main station and the sub-station, the correct voltage at this point being controlled from the central station by means of pressure wires. A very complete system of interconnection between the two batteries and the station switchboard permits practically any combination of the three to be made.



Method of Laying Conduit.

During the year 1894, which was the first complete year of operation, the cost per unit sold was 2.54d., and a dividend of 2¼ per cent. was paid. At the end of the second year the cost had decreased to 2.42d., and a dividend of 3.1 per cent. was paid to the shareholders.

The maximum charge for current is 8d. per unit for current used at the time of maximum load, namely, from an hour before sunset until 8 p. m., and on Sundays until 7 p. m., this change of hour being made to encourage the churches to use electric light. During all the rest of the twenty-four hours, the charge is 4d. per unit, the meters during this period registering only half as much for the same current passed as during the period of maximum charge. This simplifies accounts, which are made out directly from the total meter readings, all charges being made on the 8d. basis. The system of charging and the meters are due to Mr. Scott, who also designed the conduit system. The meters employed are so arranged that the current going to the lamps passes through two series coils, between which is suspended a shunt coil, the circuit of which is closed by a small relay in the meter actuated from the central station, at intervals of 1½ minutes during the full load period and 3 minutes during the rest of the day, the circuit remaining closed in each case about 15 seconds. Upon the closure of the shunt circuit the coil is deflected, the deflection being proportional to the amount of current in use at that instant. The movement of the coil actuates a train of wheels in one direction, and the calibration of the meters is necessarily arbitrary.



Method of Drawing In Conductors.

The relays are arranged in series on special meter wire circuits, separate circuits branching out from the central station to different parts of the city, the current returning by one of the mains. Each circuit requires about .75 of an ampere for its operation. A clock at the station makes the contacts with this circuit and also operates a recording apparatus attached. Motor current is supplied at 3d. per unit, and measured by Thomson-Houston and Hookham meters.

This installation is typical of the better class of English practice in stations of its size. It will be noted from the illustrations that the mains are laid under the sidewalk, near the building line in some cases, and in others in the street, near the curb.

Recovery of Gold from Cyanide Liquors.

The well-known Siemens & Halske process for electrolytic precipitation of gold from cyanide solutions has not proven very satisfactory in operation, and a new process has been devised by M. Andreoli. In this the anodes are lead plates covered with peroxide formed by the Planté process, the cathodes being plain iron plates, which are kept clean enough to allow deposited gold to adhere to them. The gold is removed by dipping the iron cathode in molten lead. It is said that the process works very satisfactorily, and it is about to be tested on a large scale.

Alternating-Current Machinery.—VII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

CHAPTER VII.

66. The simplest method of determining the resultant E. M. F. of two or more sinusoidal E. M. Fs. in series is obtained by the use of *plane vectors*. A plane vector is a quantity which possesses not only magnitude, but also direction in a single plane. It is, therefore, represented by a straight line in that plane, the length of the line representing the magnitude, and the angle which the line makes with respect to a fixed direction, representing the direction of the vector. The study and computation of alternating E. M. Fs. and currents are greatly facilitated by the use of plane vectors. It becomes, therefore, important to examine them in some detail.

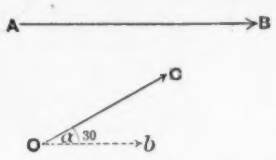


FIG. 32.

In Fig. 32, AB, represents a direction taken arbitrarily as the direction of reference. It is convenient in most cases to take this direction horizontally as shown. Then any line such as OC makes an angle α with the direction of AB, because if a line Ob, parallel to AB, be drawn through the origin O, the lines OC and Ob will enclose an angle α.

Fig. 33 represents a line of unit length drawn successively at angles, with a dotted direction line of reference, of 60°, as at OC^1,

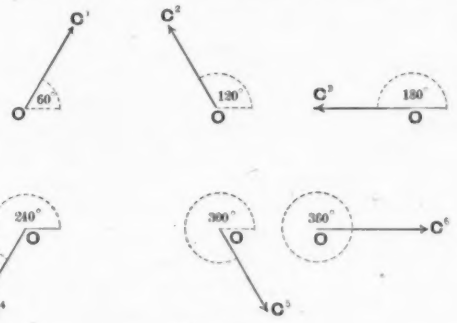


FIG. 33.

120° at OC^2, 180° at OC^3, 240° at OC^4, 300° at OC^5, and 360° at OC^6. The angles are supposed to be measured in the positive direction of rotation, that is, counter-clockwise. It is evident that if we rotate Oc, Fig. 34, steadily through the different angles above indictated from the initial position Oc_6 we obtain the successive directed magnitudes or vectors Oc^1, Oc^2, Oc^3, Oc^4, Oc^5, Oc^6, corresponding to the lines shown in Fig. 33. These lines cannot be entirely defined by their length. Their complete expression requires their angular position to be also stated. Thus the successive positions in the unit line OC_1 in Fig. 33, may be represented by the notation $1\angle 60°$, $1\angle 120°$, $1\angle 180°$, $1\angle 240°$, $1\angle 300°$, and $1\angle 360°$. It is evident that the vector $1\angle 360°$ is the same as the vector $1\angle 0°$.

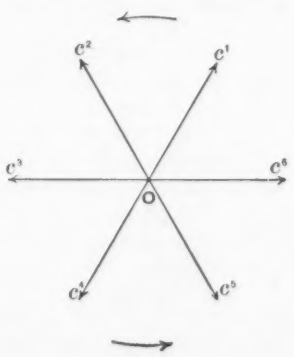


FIG. 34.

67. Another method of expressing a directed quantity is by the use of what is called *complex quantities*. A complex quantity may be considered as made up of two parts, one of which is measured in a direction along an axis of reference, and the other in a direction at right angles to the axis of reference. Thus, in Fig. 35, the plane vector OC, may be considered to be two units in length, and is directed at an angle of 30° with the line of reference OX. It may be, therefore, expressed as a plane vector $2\angle 30°$. But it may be also expressed as $Ox + xC$, i. e., a transfer from O to C, is equivalent to a transfer from O to x followed by a transfer from x to C; the sign + meaning geometrical addition and not arithmetical addition. Here, Ox is 1.732 units in length, and is measured along the axis of reference OX, while xC is 0.5 units long, and is measured parallel to OY, which is at right angles to OX. Consequently, $OC = Ox + xC = 1.732 + j0.5$. Here, the symbol j signifies that the quantity 0.5, to which it is prefixed, is measured

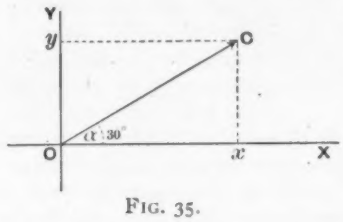


FIG. 35.

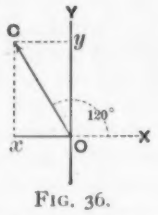


FIG. 36.

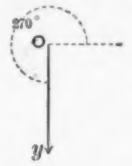


FIG. 37.

in the direction parallel to OY or in a direction positively rotated 90° from OX.

Consequently, the relation $2\angle 30° = 1.732 + j0.5$, expresses a plane vector OC as a complex quantity.

In Fig. 36 the plane vector, OC, is one unit in length and makes an angle of 120° with the line of reference OX. Consequently, $OC = 1\angle 120°$, which may be expressed as the sum of OX and XC. Here OX is measured in the negative direction, and is 0.5 units in length, while XC is measured parallel to OY in the positive direction and is 0.866 units in length. Consequently, $1\angle 120° = -0.5 + j0.866$.

Again, in Fig. 37, the plane vector, Oy, is one unit in length and makes an angle of 270° with the line of reference; or, $Oy = 1\angle 270°$. Expressed as a complex quantity $1\angle 270° = -j1$, because there is evidently no X component, and the Y or j component is in the negative direction or downwards.

68. In most cases of application of directed quantities to alternating currents it is simpler to consider the directed quantities as plane vectors rather than as complex quantities; but complex quantities are often useful in measuring and interpreting plane vectors.

From an examination of Fig. 35 it will be evident that OC, Ox and $xC = Oy$ form the sides of a right-angled triangle, so that the square of OC is equal to the sum of the squares of Ox and xC, or

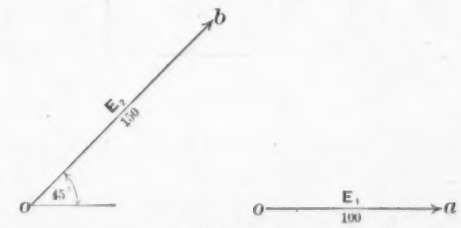


FIG. 38.

$OC^2 = OX^2 + Oy^2$. Consequently, when a complex quantity is stated, the length of the plane vector to which it is equivalent can be immediately determined. Moreover, the ratio xC/Ox is the tangent of the angle α, as tabulated in trigonometrical tables of tangents, so that from Ox and Oy the angle α can be at once determined. Conversely, when a plane vector has its length and its angle stated, the components of the complex quantity representing it can be immediately determined and its angle stated, for, in Fig. 35 $Ox = OC \times \cos \alpha$ and $Oy = OC \times \sin \alpha$. Thus, when, as in Fig. 35, $OC = 2$, and $\alpha = 30°$, $Ox = 2 \times \cos 30° = 2 \times 0.866 = 1.732$, and $Oy = 2 \times \sin 30° = 2 \times 0.5 = 1$.

69. The application of plane vectors to alternating sinusoidal E.M.F.s will be evident from the following considerations. In Fig. 38, let Oa represent a sinusoidal E.M.F. E_1 of 100 volts amplitude, and let Ob represent a sinusoidal E.M.F., E_2 of 150 volts amplitude, the phase of which is 45° in advance of E_1. Expressing these as plane vectors, $E_1 = 100\angle 0°$ and $E_2 = 150\angle 45°$. Then the E.M.F. $E_1 + E_2$, which would be obtained by connecting E_1, in series with E_2, would not be the arithmetical sum 100+150, but the vector sum $Oa+Ob$, which is obtained as in Fig. 39, by first drawing

Oa and then drawing *ab* parallel to *Ob* from the extremity of *Oa* and at its proper angle. The geometrical sum of *oa* and *ab* in Fig. 39 is *ob*, or $E_1 + E_2$, and by measurement its length is 231.6 units, to scale; while its angle is 27° 14′. Consequently, $E_1 + E_2 = 231\ 6\ \angle 27° 14'$ volts, which expresses that the resultant E.M.F. has an amplitude of 231.6 volts, and is 27° 14′ in advance of E_1 in phase.

The same result is obtained in Fig. 40, by adding E_1, geometrically to E_2 that is by first marking off $E_2 = 150\angle 45° = ob$, and then marking off E_1 horizontally from *b*, 100 units in length as *bc*. The geometrical sum is then $E_1 + E_2 = oc = 231.6\ \angle 27° 14'$ as before.

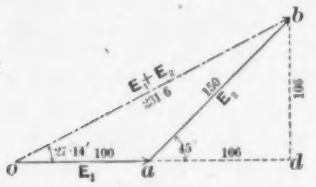


Fig. 39.

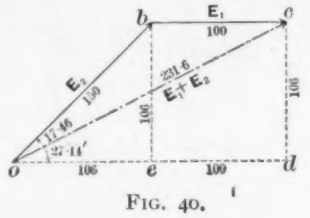


Fig. 40.

70. In the same manner it may be shown that if e_1 and e_2 are any two continuous E.M.Fs., their sum when connected in series is $e_1 + e_2$ volts taken arithmetically, but if E_1 and E_2 are any two co-frequent sinusoidal E.M.Fs. expressed not only in magnitude but also in relative phase, as plane vectors, then their sum, when connected in series, is $E_1 + E_2$ volts, which is to be taken not arithmetically, but geometrically.

This consideration is of very general application. We shall find that practically all the rules of continuous-current circuits are applicable immediately to sinusoidal alternating-current circuits, when

Fig. 41.

plane vectors are employed to represent the quantities in the alternating-current circuits. With the aid of plane vectors, therefore, the sinusoidal alternating-current circuit is scarcely more difficult to understand or to compute than the continuous-current circuit. But if plane vectors are not used, there is much more difficulty in dealing with alternating-current circuits than with continuous-current circuits.

71. In actually applying the vector summation of Figs. 39 and 40 it is sometimes difficult to mark off the angles and lengths to scale

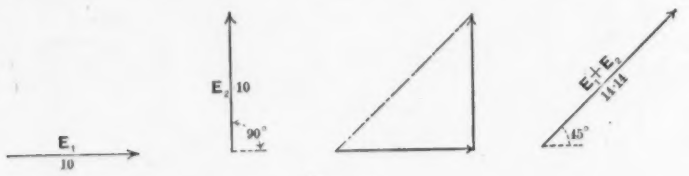


Fig. 42.

with sufficient precision for practical purposes. In such cases it is preferable to employ complex quantities. Thus, in Fig. 39, $E_1 = 100 + j0$ volts, and $E_2 = 150 \times \cos 45° + j\ 150 \sin 45° = 106 + j\ 106$ volts. The sum of these two complex quantities is obtained by adding the *OX* components and then adding the *OY* components. Thus, $E_1 + E_2 = 100 + 106) + j\ (0 + 106) = 206 + j106 = od + db$, Fig. 39, or od+dc Fig. 40. To express this as a plane vector, we have $E_1 + E_2 = \sqrt{206^2 + 106^2} = \sqrt{42{,}436 + 11{,}236} = \sqrt{53{,}672} = 231.6$, which is the length of *oc*. Again tan $\alpha = 106/206 = 0.5146$ and this, by reference to a table of tangents, corresponds to the angle 27° 14′.

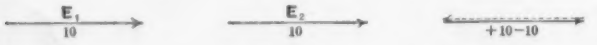


Fig. 43.

Plane vectors may be readily applied to the cases represented in Figs. 28 to 31. Thus in the case of Fig. 28 $E_1 = 10\ \angle 0°$ volts, $E_2 = 10\angle 0°$. Consequently, $E_1 + E_2 = 20\angle 0°$ as shown in Fig. 41. In the case of Fig. 29, $E_1 = 10\angle 0°$ volts, $E_2 = 10\angle 90°$ volts. Consequently $E_1 + E_2 = 10\angle 0° + 10\ \angle 90°$ and this as shown in Fig. 42 $= 14.14\angle 45°$. The resulting total E.M.F. has an amplitude of 14.14 volts and a phase angle of 45° in advance of E_1 or 45° behind E_2.

In the case of Fig. 30, $E_1 = 10\angle 0°$ volts, $E_2 = 10\angle 180°$ volts, or $-10\angle 0°$. The geometrical sum of these two quantities is shown in Fig. 43 to be zero.

Again in the case of Fig. 31, $E_1 = 10\angle 0°$ volts and $E_2 = 10\angle 270°$ volts. E_2 being 270° in advance of phase with respect to E_1. Consequently $E_1 + E_2 = 10\angle 0° + 10\angle 270° = 14.14\angle 315°$, as shown in Fig. 44, or we may take $E_1 = 10\angle 0°$ and $E_2 = 10\angle -90°$ or $10\triangledown 90°$, so that $E_1 + E_2 = 14.14\angle -45° = 14\ 14\triangledown 45°$.

72. In the same manner, it may be shown that if any number of sinusoidal co-frequent E.M.Fs. of amplitude E_1, E_2, E_3, E_n, are connected in series, their sum will be the plane vector sum $E_1 + E_2 + E_3 + E_n$, where each plane vector has its proper phase angle with respect to some particular standard or direction line. This

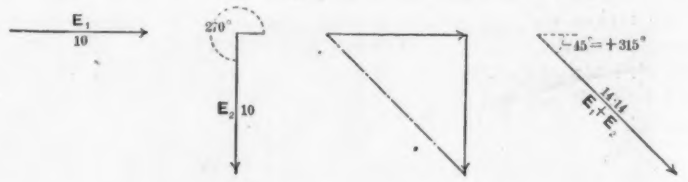


Fig. 44.

standard may often be conveniently expressed as the phase of some one of the E.M.Fs.

73. If the sinusoidal E.M.Fs., E_1, E_2, E_3, be expressed in effective values, instead of in maximum values or amplitudes, their vector sum will be the resultant effective value.

For example, two alternators producing sinusoidal E.M.F.s of the same frequency are rigidly coupled together on the same shaft in such a manner that one, namely E_1, produces its E.M.F. one-sixth of a cycle ahead of the other, E_2. E_1 is excited to produce 1100 volts effective, as shown by a voltmeter across its terminals, and E_2 to produce 1050 volts, as shown by a similar voltmeter across its terminals. What will be the total effective E.M.F. of the two ma-

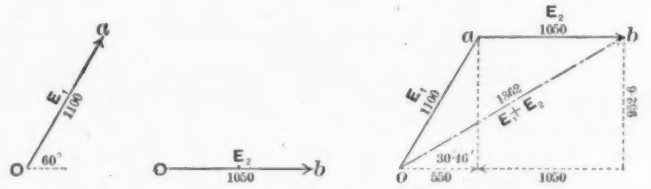


Fig. 45.

chines when connected in series? Here, E_2, being taken as the standard of reference, $E_1 = 1100\angle 60°$ volts effective, and $E_2 = 1050\angle 0°$ volts effective. Consequently $E_1 + E_2 = 1100\angle 60° + 1050\ \angle 0°$. This summation is effected in Fig. 45, where $Oa = 1100\angle 60°$, $Ob = 1050\angle 0°$ and $Ob = E_1 + E_2 = 1862\angle 30° 46'$. By complex quantities $E_1 = 1100 \cos 60° + j1100 \sin 60° = 1100 \times 0.5 + j1100 \times 0.866 = 550 + j952.6$. $E_2 = 1050 + j0$. Consequently $E_1 + E_2 = (550 + 1050) + j\ (952.6 + 0) = 1600 + j\ 952.6 = ob = \sqrt{1600^2 + 952.6^2} = \sqrt{2{,}560{,}000 + 907.747} = \sqrt{3{,}467{,}747} = 1862$. Also tan $\alpha = 952\ 6/1600 = 0.5954$, and $\alpha = 30° 46'$. The resultant E.M.F. will be 1862 volts, and its phase will be 30° 46′ ahead of E_2, or 29° 14′ behind E_1.

If the two machines were connected in series with E_2 reversed,

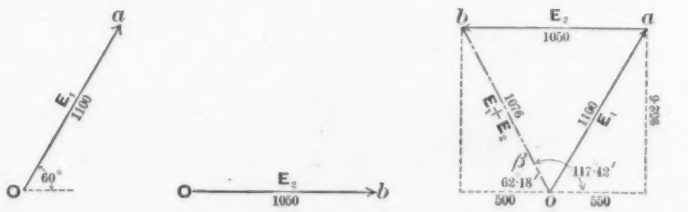
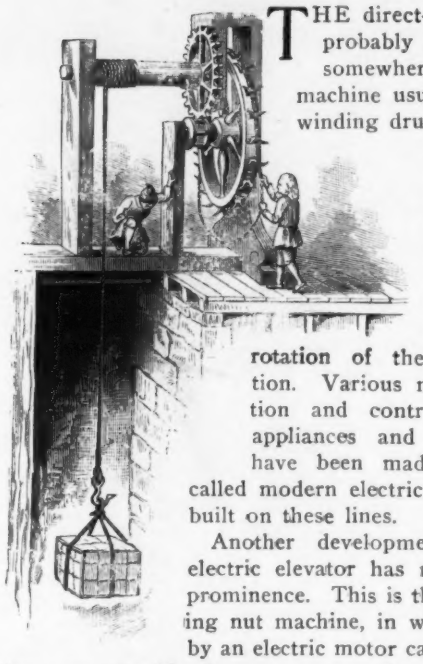


Fig. 46.

so that E_2 opposed E_1, the summation would be $E_1 - E_2$, so that *ab*, Fig. 46, would be drawn in the opposite direction to that in Fig. 45, or $E_1 = 1100\ \angle 60° + 1050\angle 180°$ and $E_1 + E_2 = 1100\ \angle 60° + 1050\ \angle 180° = 1076\ \angle 117° 42'$.

By complex quantities, $E_1 = 550 + j952.6$ $E_2 = +1050 + j0$. $E_1 - E_2 = (550 - 1050) + j\ (952.6 - 0) = -500 + j952.6 = \sqrt{500^2 + 952.6^2} = \sqrt{250{,}000 + 907{,}747} = \sqrt{1{,}157.747} = 1{,}076$. Also tan $\beta = 952.6/500 = 1.9052$. $\beta = 62° 18'$, and $\alpha = 180 - \beta = 117° 42'$. The resultant effective E.M.F. is, therefore, 1076 volts with a phase angle 117° 42′ in advance of E_2, or 57° 42′ in advance of E_1.

Electric Elevators.—II.



THE direct-connected electric elevator probably made its first appearance somewhere about 1888. This type of machine usually consists of a modified winding drum machine with an electric motor directly coupled to the screw shaft. Starting, stopping and reversal of the drum is accomplished by the movement of a suitable device operating the motor controller and brake devices to effect rotation of the motor in either direction. Various modifications in the operation and control of the motor, safety appliances and the hoisting mechanism have been made, but generally the so-called modern electric drum hoisting elevator is built on these lines.

Another development of the direct-coupled electric elevator has recently attained particular prominence. This is the so-called screw and sliding nut machine, in which a screw shaft rotated by an electric motor causes a crosshead nut carrying a set of cable sheaves to move along the cable shaft. The cable system connected with the car passes over the movable sheaves and also over a set of fixed sheaves, the movement of the former causing a corresponding movement of the cable attached to the car in a predetermined increased ratio. In the hoisting and lowering action this machine resembles the hydraulic method.

These two distinct types of electric elevators and their modifications are practically the sole commercial types in general use today. Other methods have, however, been devised and patented, and some of these embody ingenious if not entirely feasible features. In most of these methods the electric motor is placed on the car. One of these methods employs a cable anchored at both ends and passing through the car. The motor is equipped with gripping sheaves firmly clamping the car, or around the latter is given one or two turns, and the rotation of the grip sheaves by the motor in either direction raises or lowers the car. Another arrangement includes a set of vertically placed racks, with which a pinion rotated by a motor on the car engages. The pinion is replaced by a rotating screw in another plan. There have also been several other peculiar methods devised. One of these particularly attracted the writer's attention recently. The motor device consists of a very large fixed solenoid coil acting on an iron core, which is connected by a suitable cable to the car!

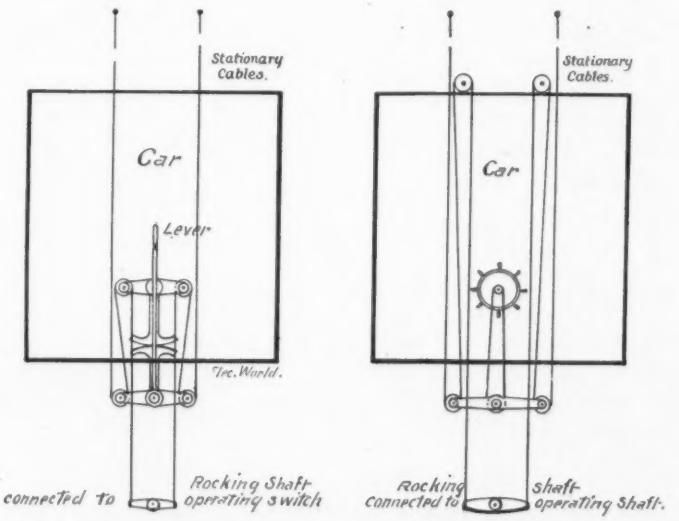
In order to dispense with large and wide drums, necessary with drum hoisting machines for long lifts and high speeds,, a modified form of drum hoisting elevator has been devised. In this type of machine one end of the cable is fastened to the bottom of the car, passing from there over suitable sheaves to the lowest point in the hoistway to a gripping sheave rotated by an electric motor, and after making several convolutions around the grip sheave, it rises to the highest point of the shaft, where, after passing over the necessary top sheaves, it descends to the car and is fastened to the upper part thereof. The rotation of the motor causes a movement of the cable up or down. This method, as will be readily seen, dispenses with a large amount of cable wound on the drum, but has the objection that it is difficult to prevent the slipping of the cable upon the grip sheave, and the absolute stopping of the car at certain fixed points is, therefore, not always assured.

The direct-connected electric elevator, either of the drum or screw-and-nut type, involves a number of general features which need consideration. The type of motor necessary is essentially different from the motor which can be satisfactorily used to drive a belt hoist provided with belt-shifting starting devices. Direct-connected elevator motors are usually of the direct current, constant potential type, and operate at fairly low speeds, of about 600 or 800 revolutions per minute. As the motor must start a loaded car from rest to maximum speed with an acceleration as rapid as smoothness of movement will allow, it is necessary that the motor should have a powerful starting torque with a gradual, though rapid, increase in speed.

The first condition is taken care of in the motor itself, while the latter usually depends upon the controlling devices. A heavy shunt field motor is sometimes used, but in most machines the motor is compound wound with a series of starting field winding and a shunt winding serving to steady the field. The current necessary to start the motor depends upon the rate at which a certain load is to be accelerated. With a slow acceleration the starting current will certainly be less than where it is desired to very rapidly accelerate the load from rest to maximum speed. The acceleration under ordinary conditions should be, however, as rapid as possible, consistent with efficient operation of the elevator car. The motor controlling devices should give these desired results, allowing the motor to receive the required current with a minimum expenditure of wasted energy in the controlling devices. To obviate this waste of energy in the controlling devices and minimize the starting current, arrangements of clutches between the motor driving shaft and the hoisting mechanism have been used which operate automatically after the motor has attained a certain speed. Other methods will be described later. The actual motor controlling apparatus is, in most instances, of the rheostatic type. In the early development of electric elevator motors, commutating switch devices controlling the field windings of the motor were employed, but this arrangement is not now used extensively. When the motor is operated by the current in both ascending and descending, the controlling apparatus includes a main and reversing switch, the latter changing the armature connections, and a starting rheostat connected in series with the armature and series coil. Where the motor is used only for hoisting, the car being lowered by gravity, as is the case with certain machines, the reversing switch is dispensed with and in its place some arrangement is provided to either control the descent of the car by regulating the brake or by the action of the motor running as a dynamo, upon a resistance.

Two types of controlling apparatus are generally used in practice—one in which the motor speed is varied by means of a variable controller operated mechanically or electrically, and the other in which the speed is fixed, the motor being controlled by an automatic starter used with separately actuated switches. In the first method, where the controller is operated by some directly connected mechanical operating device from the car, the operation of the controller is apt to be too rapid, causing an unnecessarily great rush of current and jerky starting.

In the fixed speed method either of the previously described automatic starters can be used. With the electrically actuated

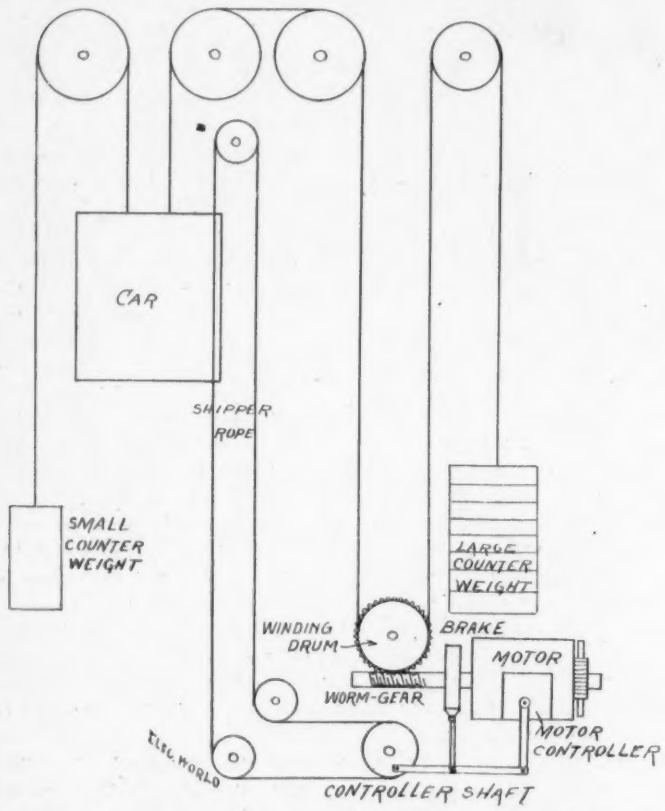


LEVER CAR CONTROL. WHEEL CAR CONTROL.

starter an electro-magnetic device connected in series with the motor is sometimes used, which therefore operates the starter at a rate inversely proportional to the acceleration of the motor speed.

The control of the motor by varying the voltage at its terminals without the use of wasteful resistance in the main circuit is another method which presents various advantages. For such operation the storage battery could be used to supply the current, and a commutation device could be arranged to vary the number of cells in series connected to the armature. Suitable arrangements could be made for charging the battery either continuously or at intervals. Such a method would embody the various advantageous

features of a non-rheostatic variable voltage supply regulation at the motor terminals, with the additional advantage to be gained by the use of a storage battery supply system for work of this class. Such an arrangement must provide for the even discharging of the various cells. Another method of voltage regulation is known as the Leonard system of control, in which the voltage supplied by the generating dynamo is varied. This method will be described later, in conjunction with certain types of electric elevators. The advantages directly due to a variation of the supply voltage are more or less alike in both methods.



Direct-Connected Electric Drum Elevator—Mechanical Hand-Rope Control.

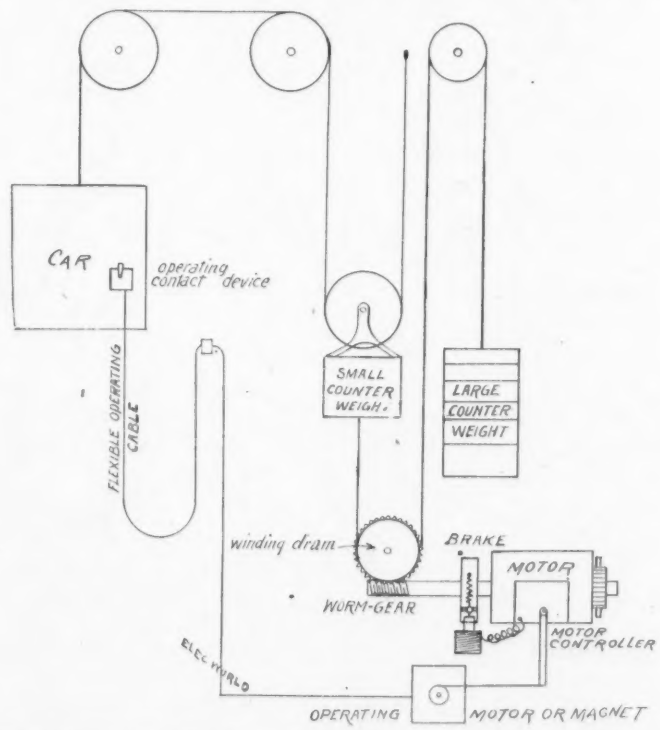
The controlling apparatus may be operated from the car either by mechanical means or by suitable electrical pilot devices. The simplest form of mechanical operating device usually consists of an ordinary hand rope passing through the car, which is pulled in either direction by the operator. Lever and wheel devices giving the necessary movement to a cable with which they engage are also employed. In either case, movement of the starting rope, or shipper cable, as it is ordinarily called, imparts a rotary movement to the shaft connected to the controller switch or motor starting devices. With the ordinary hand-operated starting cable passing over a sheave mounted on an actuating shaft, the greatest simplicity is probably obtained, and the car can be operated by either the operator in the car or from any landing. There is, however, no absolute indicating arrangement attached to a device of this kind to show whether the car is going up, down, or is at a standstill. With the wheel or lever devices a certain position indicates the condition of the car. Such devices are also easy to operate, although involving a somewhat more complicated arrangement of starting ropes.

In the electrical method of operation a suitable contact device is located on the car, and connected by suitable wires with a magnetic actuating apparatus, which in turn operates the main motor controller and switches. The magnetic operating device may be either an electromagnet, solenoid, or a small electric motor, but should be arranged to give a movement to either side of a certain stop point. The main motor should also be directly controlled from the car, but the necessary cable to and from the car, particularly with long lifts, would be very cumbersome, aside from the energy which would be expended in them. This method is, therefore, never used in practice.

While the mechanical hand rope operation is exceedingly simple and positive, yet it has some objections. Electrically operating devices are not only exceedingly easy to work, requiring no particular exertion on the part of the operator, but can be made entirely automatic, and can also be placed on each landing as well as on the car. The operation of the controlling switches and rheostat may be either combined or separated with either method.

For private house service, various plans have also been recently developed in which the car is automatically controlled by suitable devices located on every landing and also in the car. The operation of any of these devices starts the motor, raising or lowering the car until the particular point designated by the device operated is reached, when the motor is automatically stopped. Such methods usually embody some form of electrical contact or switch at the various points from which the car is to be operated, connected by suitable wires to an electromagnetic starting apparatus which works the motor controller. The hoisting mechanism is provided with stops operating automatically when the designated floor is reached. It should be impossible to operate the car from any control apparatus while any other is being used, and the entire system should be inoperative if any of the hatch doors are open. Any drum machine can be provided with such control mechanism.

Safety is probably the prime requisite, particularly in a passenger elevator. Every possible safeguard must be provided to absolutely prevent an accident to the passengers in the moving car. Direct-connected electric elevators are, therefore, necessarily fitted with various automatic safety appliances, the general desideratum being to stop the car and hold it in case of any disarrangement of or accident to the elevator mechanism. Elevator cars, whether operated by belt, steam, hydraulic cylinder, or electric motor, particularly those intended for passenger service, are usually equipped with some form of clutch arranged to grip and hold the car on the guides when it is actuated by a suitable speed governer. This is usually of the centrifugal form and placed either on the car or at the top or bottom of the shaft, connected in the latter case by a cable with the clutches on the car. In addition to the centrifugal governor, a broken or slack cable safety contrivance is sometimes provided by fastening the hoisting cables to a flat spring which is kept under tension by the weight of the car and pull of the cables. This spring when its tension is released, either by the sticking of the car in the shaft or a broken cable, actuates either the same or similar clutches, causing the car to be held to the guides. In addition to these safeties it is, however, essential to provide several automatic devices on the elevator-machine itself. Such safeties usually include upper and lower travel limit stops, which operate when either limit of travel is reached, and a slack cable stop which operates if the cable should be slackened from any cause. In some cases an excess speed safety is also provided on the elevator mechanism, arranged to operate when the speed of the motor exceeds certain limits. These safety appliances can be best described



Direct-Connected Electric Drum Elevator—Electric Control.

with the various machines of which they form a part. Their function is to automatically stop the motor and apply the brake. When mechanical operating devices are used another automatic limit stop is usually provided. In the case of hand rope operation a stop block is clamped to the upper and lower ends of the operating rope in the shaft. The car strikes this block and moves the operating cable, bringing the controller shaft to the stop position.

(To be continued.)

Controlling the Speed of Car Motors.—I.

BY WM. BAXTER, JR.

There is no question in relation to the operation of railway motors that is, apparently, so imperfectly understood as that of speed regulation. Engineers, whose conclusions are based wholly upon theoretical reasoning, lose sight of certain points, only revealed by practical experience, and, as a result, assume the operations to be very different from what they really are. Some of these men, being of a pessimistic temperament, take it for granted that the practical possibilities are not much above the lowest theoretical limits, and, therefore, are willing to accept as true any assertions that may be made which tend to show the crudeness of the art in this respect.

Since the champions of electricity first became bold enough to assert that the electric motor could do the work of the steam locomotive and would gradually invade the trunk railway field, its opponents have tried in every manner they could think of to show for this or that reason it would fail to meet the exacting requirements of this form of transit. One of these reasons is said to be the inability to properly control the speed of the train; but the explanations that are given of the operation of present and past methods of controlling the speed of trolley-car motors to prove the correctness of this assumption only show that these men, who attempt to sit in judgment upon the merits of the methods in use, are not familiar with their practical operation.

It is asserted that the rheostat method of control is not desirable on account of the great loss of energy occasioned by the introduction of resistance into the circuit; that the commutated field method is not much better, because there is a constant danger of burning out the field coils, and that at the best it only gives a few changes in velocity. As to the series-parallel method, it is claimed that it only affords two speeds, and as an offset to this possesses the defect of permitting one motor to run at a high velocity while the other stands still. All these objections would be good if the operation of the various systems were just as assumed by the critics, but, as a matter of fact, they are not.

The first experimenters in the railway field naturally concluded the easiest way to vary the speed of the motors was by the introduction of a sufficient amount of resistance into the circuit to balance the E. M. F. of the operating current in excess of that needed to develop the required speed; and consequently this method of regulation was adopted. In order to be able to effect a considerable variation in velocity it was believed to be necessary to make the rheostat of sufficient resistance to offset the greater part of the E. M. F. Hence in the first efforts, the resistance was about 18 or 20 ohms. As the rheostat would not be in service all the time, it was evident that the current-carrying capacity of the wire could be made considerably less than that required for a continuous run. These rheostats were decidedly bulky; but, notwithstanding this fact, they frequently gave out through their inability to carry the current. To make them more substantial, the construction was changed so as to make them fireproof, but even this did not remove the difficulty.

Seeing that the best construction was not proof against burnouts, it was sought to ease the task of the rheostat as much as possible by instructing the motorman not to use it any more than was absolutely necessary. As a result of this precaution it was soon found that the most intelligent motormen could run the car without using the rheostat, except in starting and on rare occasions when under actual headway.

Seeing that the rheostat was not actually needed as a regulator, it became evident that its resistance could be reduced to a point where it would be just enough to prevent the car from starting with a jerk. Gradually the resistance was reduced until it was not greater than four or five ohms, and in some cases, where the coils were so made as to possess high inductive qualities, the resistance was lowered to even less than three ohms, the choking effect serving to cut down the initial current to such an extent as to prevent a too sudden start.

Those who believe that the speed was regulated almost entirely by the introduction of resistance in the circuit in the old rheostat system, or that it is materially controlled by the same expedient in the series-parallel system, may not be willing to believe that they are mistaken, but that they are can be easily shown by a consideration of the fact that the total resistance of the rheostat, in either case, is too small to effect any noticeable change. The truth of this statement can be more forcibly shown graphically, as in the diagram Fig. 1, than by any other means.

In this diagram, the two upper curves show what the speed of a car would be with currents ranging from 15 to 40 amperes, with the whole rheostat in circuit and out of circuit. The two lower curves show the change in velocity effected in the series-parallel system, when the motors are connected in series, and the same amount of current is passing through each, as in the former case.

These curves show the effect of the rheostat when the current is small, but it is hardly necessary to show what it would be with stronger currents, because these are the accompaniment of low velocities, and it is only in the case of high speeds that regulation is necessary; hence, the curves cover the range of velocities over which the rheostat is supposed to act.

Since it is quite clear from these curves that the effect of the rheostat upon the speed is very slight, and since it is a practically demonstrated fact that trolley cars run at widely different speeds, and that the regulation is perfect enough for all practical purposes, it may be asked, how is the regulation accomplished? The answer is quite simple. It is merely the result of skill on the part of the motorman, skill of the kind that can be acquired by any man of fair intelligence after a few weeks' practice.

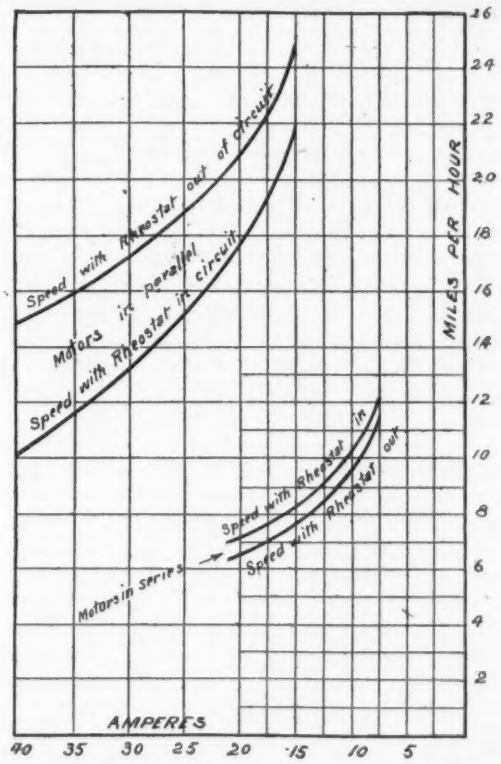

Speed with Rheostat out of circuit
Motors in parallel
Speed with Rheostat in circuit
Speed with Rheostat in
Speed with Rheostat out
Motors in series
MILES PER HOUR
AMPERES
40 35 30 25 20 15 10 5
2 4 6 8 10 12 14 16 18 20 22 24

FIG. 1.—CURVES SHOWING EFFECT OF RHEOSTAT ON SPEED OF CAR.

With the old rheostat method, the process of regulating the velocity was about as follows: When the car was started the switch handle was turned around as fast as it could be without starting the car too suddenly. Soon the speed would become greater than the maximum limit. At this point the switch would be turned so as to cut the current off entirely, and the car would drift along under the effort of the acquired momentum. The speed would gradually reduce, but far more gradually than would be supposed. After running several hundred feet, it would drop as far below the desired velocity as permissible, and then the full current would be turned on again, the cycle of operations being repeated as often as necessary to maintain the desired average velocity. If a car, provided with a series-parallel controller, is working its way through a crowded street, the switch handle will be turned as far as the series combination, and as soon as the speed exceeds that desired by an amount that, in the judgment of the motorman, is as much as is permissible, the switch is turned and the current is cut off, the car being allowed to drift along until the velocity becomes so low as to

require another impetus. In this case, just as in the former, in which the operation of the rheostat was explained, the various velocities below that corresponding to the series connection are not obtained by cutting into the circuit a sufficient amount of resistance to effect the required change, but by running without resistance and at a higher speed than that desired, and then drifting along without current as great a portion of the distance as may be necessary to make the average velocity equal to the requirements of the occasion.

Whenever the track is not obstructed immediately ahead of the car, the motorman will turn the switch around to the parallel connection, even if a run of only one or two hundred feet can be made before coming to a stop. Any one who will sit in the front end of a trolley car and observe the manner in which the motorman manipulates the switch will find that the operation is just about as explained above, and if he is one of those who suppose that the rheostat is used very extensively, he will be surprised to find that even in starting it is kept in the circuit for a much shorter time than would seem to be actually necessary. When the car is started on a level track, or a slight down grade, it is not uncommon for the switch to be turned all the way around to the last notch while the car is moving through a distance of fifteen or twenty feet. Motormen know from experience that to make good average speed they must not lose any more time than is actually necessary, and on this account they turn the switch handle, in starting, just as fast as it can be turned without causing the velocity to accelerate with violence.

Although the methods of controlling the velocity that have come into extensive use are not perfect from a purely ideal standpoint, they are sufficiently so to meet all the requirements of trolley cars, and as these requirements are as exacting as those in any other line of railroading there is no reason to suppose that they would fail in any other field. But it may be asserted by steam engineers that a more positive system of control is necessary on trunk roads, and in support of this assertion it may be cited that steam locomotives can be run at any desired velocity below the maximum, by simply setting the link motion lever, or the throttle valve at the proper point. This, however, is not strictly true, as the means mentioned will not give uniform velocity unless the steam pressure remains constant, which it does not at all times. It is true that the variation is small, but it is enough to cause a noticeable change in speed. Every one who has observed the running of railroad trains is aware of the fact that they do not maintain a uniform velocity. This lack of uniformity is not due wholly to the inability of the locomotive to keep up a constant velocity, but almost entirely to the fact that the configuration of the track will not permit of it. In rounding curves, crossing switches, etc., it is necessary to reduce the speed, and about the only places where uniformity can be maintained is on straight tracks. These, however, are almost invariably in short stretches, over which the train will speed in a few minutes; therefore, since the condition of the roadway will not permit of uniform velocity, it is reasonable to assume that a system perfect in this direction would be of little value, from the fact that its capabilities could not be utilized, except to a limited extent. This reasoning may not be accepted as sound by those who insist that if electric motors propose to become competitors of the locomotive, they must be equal to them in every respect, except those in which they are superior; that if they show superiority in some respects, and inferiority in others, the disadvantages may offset the advantages, or even more, thus leaving a surplus of good qualities in favor of the opponent. This view of the case is not an unreasonable one to take, and if it were not possible to meet it, by showing that there are ways in which speed control can be made as perfect as desired with electric motors, we would be compelled to admit an inherent weakness in this respect.

That nearly perfect methods for controlling the speed of motors are available is well known, but they are not used on electric railways because the present devices are entirely satisfactory, and furthermore, very simple, while more perfect systems would be more complicated, and it is not considered wise to introduce complication to derive an advantage that practice shows would be of little if any value. This same argument could not be brought against the use of such devices in connection with electric locomotives, or motor cars of sufficient capacity to do the work of steam locomotives, for the simple reason that what may be regarded as inadmissible complication in connection with a small machine may not be such, when regarded with reference to apparatus of several times the capacity.

(To be continued.)

Charging for Electrical Energy.

To the Editor of The Electrical World:

Sir—Your editorial in a recent issue, while interesting and in the main fair, contains a few statements which may prove misleading. In the first case the principle of giving discounts or low prices to those customers who use their lights long hours is by no means solely a foreign invention, but has been for a long time in use in some of the American companies. The difference has been that abroad where the companies are fettered by government and municipal regulations they have from the first been obliged to state their methods in formal systems, while in America, though many of the companies have been accustomed for years to give discounts and low prices to the long-hour customers, the figures have been determined in each particular case by the superintendent's estimate, or occasionally by some more or less arbitrary rule. These discounts reach in some cases to 70 per cent. and 75 per cent. off of the price charged to the very short-hour customers. The necessity for some such system is shown by the fact that in spite of these discounts these long-hour customers are more profitable to the company than the short-hour customers who apparently pay a higher price.

The storage battery, while a very useful piece of apparatus, only improves the load factor of the generating machinery, which is only the smaller portion of the investment. The storage battery has no effect on the load factor of, for instance, the distributing lines, and it is obvious that if these can be made to carry current during hours when they are now idle, there will be a large increase in the profit that will be available for dividends.

The point that a lower price will not increase the consumption of electricity at particular times of the day is one that is sometimes made, but it is a very fallacious one. Why does a customer ever try to reduce his consumption at all? And if the customer finds that he saves very little by turning his lights out early, but a great deal by keeping down the total number of his lights, then will he not, whenever he tries to save on his light bill, direct his efforts where they will do most good to himself, and incidentally to the company by reducing the load factors?

Even leaving out the present customers, the effect on whom depends partly on the particular system of long-hour discounts adopted, why is it that there are so many customers of the gas companies right in the streets where our electric mains are laid? Does anybody use gas who can afford electricity? But there are a great many of these gas customers who use their light long hours, and if the electric companies will only grade their prices according to the length of time the light is used they can secure thousands of these new long-hour customers at a profit.

The fact that both in Europe and America the progressive station managers have adopted the principle of long-hour discounts with the best effect on their load factors and on the ratio of dividends to capital invested shows that the real question now to be determined is merely as to the form of the long-hour system that will be found most applicable to any particular company or district.

The point, of course, is not to force the customer to do one thing or another, but to offer a low price to those customers who do or who are willing to use the current in the way most profitable to the company.

Boston, Mass. R. S. Half.

Automatic Telephones Robbed.

In Toledo, Ohio, the Central Union Telephone Company has a number of pay stations, where automatic toll-boxes are used to collect charges for long-distance conversation. Collections are made from these drawers once a week. A few days ago, just before the collector made his rounds, thieves went through the boxes of four of these instruments, prying open the locks and extracting a considerable sum of money from each. It is believed to be the first time that such instruments have ever been robbed.

Niagara Meeting of the National Electric Light Association.

We are informed that the Trunk Line Association has granted a rate of a fare and one-third, for the round trip, on the certificate plan, from all points in its territory to Niagara Falls, for delegates and members of the National Electric Light Association attending the twentieth convention to be held June 8, 9 and 10, 1897.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Formulas for Transformers. RUSSELL. Lond. *Elec.*, March 26.—A somewhat long article in which he shows that certain formulas can be established without assuming that the currents and potentials follow a sine law; in proving the formulas no assumptions are made as to the shape of the curve of the E. M. F. or the permeability; this prevents him from giving a formula for the magnetizing current of a transformer, but he gives some formulas which he claims to be very useful connecting the primary and secondary currents and pressures and the hysteresis loss in the core; leakage as a rule has been considered a negligible quantity; no knowledge of mathematics beyond elementary algebra and trigonometry has been assumed; no knowledge is required of self or mutual inductances; he uses simple triangular diagrams and thinks they will be a real help to practical men in enabling them to obtain clearer ideas of the action of alternating currents.

Multiphase Induction Motors. EBORALL. Lond. *Elec. Rev.*, March 26.—The beginning of an illustrated article treating the subject from a practical point of view and discussing the general principles underlying the construction and operation of such motors; it is of a general and somewhat elementary character.

Constant Speed Motors. JOYCE. Lond. *Elec. Rev.*, March 19.—A continuation of his criticism of the article by Rhodes (see *Digest* March 20 and 27).

Commutatorless Continuous Current Dynamo. DE PUYDT and PONCIN. Lond. *Elec. Rev.*, March 19.—A brief statement of their method of reasoning in the construction of such a dynamo (see *Digest* Feb. 27); it is vague, unintelligible and unscientific.

Comparative Commercial Qualities of Alternating Current Motors. WILLIAMS and PERKINS. *Wisconsin Engineer*, October.—A short article accompanied by a table, and a large number of curves giving the results of a series of tests showing the comparative performance of such motors with each other and with standard direct-current motors; 5-hp motors were obtained from five prominent makers; data was also obtained from recent tests of three others. The power was measured by direct reading wattmeters and the outputs by a modified form of prony brake, which is spoken of very highly and which is illustrated; the static torque was found by clamping the brake and balancing the pull of the motor, while the true starting torque was obtained by diminishing the load until the motor would start and increase to full speed. They found that when the motor has a small self-induction and a well adjusted and divided starting resistance, a large starting torque may be obtained without an excessive flow of current; most of the machines tested were not the equals of standard direct-current motors in starting torque, but this defect is easily remedied as described above; in regulation and efficiency alternating-current motors are fully equal to the best direct-current motors; all the American motors with a single exception were found inferior to the foreign ones in power factor; until the power factors are improved, central stations may well hesitate about using such motors except for long-distance service; of the six motors tested only two could be started under load without seriously affecting the lights of the system; both of these are American; although the names of the motors are given the results are not connected with those names; the line pressures were most seriously affected by the induction motors when the wave form was peeked and irregular, and least affected when it was sinusoidal, but this is not conclusive; a generator having a sine curve should give the most satisfactory service for induction motors; central station generators from which induction motors and lights are to be run should have the smallest possible armature reactions, otherwise when the generator load is light the starting of the motor is sure to affect the lights disastrously. The reduction of the wattless current and the improvement in the power factor by condensers in parallel with the primary, is shown in curves. For comparison, the efficiency curves of several of the latest types of direct-current motors are also given. They believe the following conclusions are justified: Induction motors give as good regulation and efficiency as direct-current motors; they may be made to have, and some do have, as good starting torque as direct-current motors; their starting torque may be made as high as necessary without using an excessive starting-current; only generators having small armature reactions and approximate sine curves should be used to operate both lights and induction motors; such motors and generators are furnished by at least two American manufacturers; for power distribution the polyphase motor is the ideal.

Separating the Losses in Three-Phase Motors. TRUE. *Wisconsin Engineer*, Jan.—An article in which he shows how the losses may be separated and gives a comparison of these losses on balanced and unbalanced circuits. The separation of the losses was carried out for several loads which made it possible to compute the efficiency and power factor curves, thus giving a no-load efficiency test. The iron losses are obtained from the reading when the machine is running light; the C^2R losses in the field are computed; the bearing losses are obtained by taking the speed carefully and then cutting off the power and noting the time in which it takes the motor to run down; the total loss as read from the wattmeters less the friction and the C^2R losses gives the iron loss. One of the motors tested was a modern 5-hp three-phase motor and the other a 5-hp induction motor built four years ago; the results of the tests are given in tables and curves. The bearing loss of the first motor is about 15 per cent. of the full load loss; the iron loss is 29 per cent. and the C^2R loss 56 per cent. of the full load loss; a lack of balance increased the iron loss about 50 per cent. and the C^2R loss 30 per cent. In the second motor the bearing loss is 10 per cent., the iron loss 20 per cent. and the C^2R loss 70 per cent. of the full load loss; an unbalanced circuit increases the iron loss 50 per cent. and the C^2R loss over 50 per cent.; the efficiencies are from 4 to 5 per cent. lower when the motors are run on unbalanced circuits; the no-load test could not be depended upon with unbalanced circuits; on unbalanced circuits it is probably correct within 1 per cent. The paper is also discussed briefly in an editorial in the same issue.

Speed Control of Motors. BLOOD. *Elec. Eng.*, March 31.—A reply to the statements of Anthony, noticed in the *Digest* Feb. 20. He claims that Anthony's motor is not multipolar but bipolar, which fact, he says was at first not clearly pointed out; he cites a German patent by Bauch which is even older than the other one cited before; one of the diagrams is reproduced and is said to plainly illustrate the idea. He objects to the "antiquated method" of accounting for sparking by the disappearance of the lines and of similar phrases used by Anthony; this he claims to be a common error with which he intends to deal in a subsequent Institute paper.

LIGHTS AND LIGHTING.

Luminous Efficiency of the Arc. BLONDEL. *L'Eclairage Elec.*, March 13 and 20.—A continuation of his long paper (see *Digest* March 13). At the end of the latter installment he draws the following practical conclusions from his very elaborate researches: With a given constant current and for given diameters of the carbons, the luminous flux increases at first with the voltage, but from that point through a certain range, generally from 40 to 50 volts, the flux decreases; below 45 volts the variation of flux can be represented approximately by a straight line law containing two constants which depend upon the carbons and the intensity of the current; the efficiency varies inversely as the diameter of the carbons, but the law of inverse proportions given by Schreihage was not always verified at a constant voltage; for a constant voltage and diameters the flux varies as a function of the current approximately according to a hyperbolic law within the possible limits; at a constant current density the efficiency is higher for arcs having a large current; the influence of the material of the core is very important both in the effect on the electrical quantities and in the production of light; in general anything that lowers the voltage for a certain length of arc, at the same time lowers the efficiency; special carbons for the low voltage do not improve very much the efficiency at low voltages and reduce the maximum efficiency. In general it is desirable to study the law of variation of the efficiency, which is often incorrectly assumed as constant; for the best efficiency, carbons of the smallest diameter possible should be used, the carbon should be soft and the voltage should be that for the maximum light; but these conditions are not always compatible with the practical requirements, such as the length of time during which the lamp will burn; it may even be said that anything which increases the duration of burning reduces the efficiency; the makers should study the best conditions for each special case; grouping lamps in threes or fours is rarely an advantage unless it be done to subdivide the light; the quality of the carbon, that is, the purity, has an important effect; the use of lamps having a long course or having two pairs of carbons, is at present the best solution of the problem; it is much more economical at the ordinary cost of electrical energy in cities, to force the consumption of carbon instead of increasing the number; in the same way it is best to use large units than small ones; if the reverse is required it is always at the expense of the combined efficiency; it is often irrational to require a high efficiency of the dynamos while there is a loss of 50 per cent. or more in the luminous efficiency of the lamps.

Edison Lamp Socket. BAUTZE. *Elek. Zeit.*, March 18.—An article in which he calls attention to the lack of uniformity in the screw base socket for incandescent lamps made by different manufacturers; in view of the fact that this base has been recommended as the universal one, he urges that a uniform system of its dimensions be adopted. After a brief illustrated history of the older forms of Edison bases, he gives a table containing the similar dimensions of these screw bases on 24 lamps from about 10 different makes in Europe; showing the great lack of uniformity; this is followed by a discussion of the effects of some of the dimensions and by an enlarged drawing of the thread as now frequently made.

Electricity and Photography.—Lond. *Elec. Eng.*, March 26.—An illustrated description of a recently erected photographic establishment in London in which a triple arc lamp is used together with a fog-dispelling apparatus.

Search Lights for Coast Defence. Boyd. *Elec. Jour.*, March 15.—An abstract of the article noticed in the *Digest*, Nov. 20.

Chemical Lamp Exhaustion.—Elec. Eng., March 31.—A brief illustrated description of the method of pumping used in the Edison Lamp Works. Mechanical vacuum pumps for exhausting a large number of lamps at a time were tried but were discarded; success, however, was obtained with small mechanical pumps used for only one lamp at a time; the lamps thus exhausted are said to be superior in every respect and this method is now used entirely. The residual gases are then exhausted chemically by the introduction of a gas capable of combining with these residual gases, during which time the filament is brought to a high degree of incandescence; the combination of the two gases is indicated by the sudden disappearance of the blue glow in the bulb; when this has taken place the lamp is sealed off; no further information is given concerning this chemical method.

POWER.

Long Distance Alternating Current Transmission. Esson. Lond. *Elec. Eng.*, March 26.—The beginning of a reprint of a Society of Arts paper. He divides the subject into transmission with various phases and begins the discussion of generators, giving general hints as to their desirable properties and construction; he calls attention to the importance of the mechanical strength of the insulating materials on the armature; he prefers stationary armatures, and shows that the armature reaction should be very small; a generator with 10 to 15 per cent. drop would be quite unsuitable for running non-synchronous motor circuits; some efficiency may sometimes be wisely sacrificed to reduce this drop; the power factor is explained and its importance pointed out.

Irrigation at Korachieh, Egypt.—L'Eclairage Elec., March 6.—A brief reference to an installation about to be made in which electric transmission of power is to be used for operating the pumps for a large irrigation plant; the length of the transmission is from 3 to 8 km and the continuous current will be used.

Local Distribution in Workshops. Scott. Lond. *Elec. Eng.*, March 19.—A continuation of his serial. He gives tables of the power required for woolen mill and flax mill machinery and discusses the use of friction clutches, which he advocates in some cases; he begins the discussion of the wiring.

Rheinfelden.—Lond.—*Elec.*, March 26.—A long, well-illustrated description of this water power installation, references to which have been given frequently in these columns.

Electric Pumping Stations in New Orleans. Eng. Mag., March 25.—An extract containing itemized estimates, from a report by Raymond, of the probable cost of operating the various pumping stations for the drainage system of that city, by steam and by electricity. The costs for both are itemized in the extract; real estate and foundations are not included, but the results would be greatly in favor of electricity for these items; the cost of construction in case electricity is used is about 50 per cent. greater, the cost of operation considerably less and the interest and depreciation considerably more. Another estimate is given for the partial operation of several of the pumping stations and the result of this is considerably in favor of electricity; it is furthermore thought that the actual results would show even greater differences in favor of electricity; the latter plans are the ones to be adopted.

Electric Motors in Factories. Conradson. *Wisconsin Engineer*, October.—An article discussing the general subject of motors in factories and advocating direct-connected motors wherever possible, even on the smallest tools and machines. He made a complete power test of about 200 machines in a large factory to determine if electric motors can be profitably substituted for the belt and gives the conclusions in curves showing the expected electrical efficiency. Many of his arguments are already understood; among other things he comes to the following conclusions: That, the most efficient means of driving machine tools is by direct-connected motors to each tool; the cost of such motors is considerably more than if the line-shaft method is used, but the total cost of the plant need not and possibly will not be as large; the efficiency of the direct-connected plant will be at least 10 per cent. higher than of the line-shaft driven plant; the cost of maintenance will be about the same in each case.

Design and Construction of Electric Power Plants. Arnold. *West. Elec.*, April 3.—The first part of a reprint of a series of lectures delivered at the University in Nebraska; this series is to extend over a period of three months in that journal; he intends to give "under each subject certain theoretical laws upon which it depends, and sufficient elaboration thereon to help us get them well before us while showing their application in practice," assuming a knowledge of the theory of the subject. The present portion is devoted to the possible sources of energy; it is very general in character and covers the complete field, including a brief thermo-dynamical discussion of heat engines.

Economy in Transmission. Warren. *Engineering Journal*, February.—An article in which he discusses analytically the most economical conditions in the transmission of electric power. He takes into consideration the fact that the first cost of a conductor is not strictly proportional to its size, and the cost of installation may vary but slightly for a wide range of sizes. He therefore divides the first cost of a conductor into two parts, one of which is constant for all sizes of wire and the other is directly proportional to the size, and in this form he obtains a simple expression for the cost of a line. In the same way he obtains a similar expression for the cost of the installation. He then applies these to the various conditions, obtaining simple formulas for calculating the most economical conditions.

TRACTION.

Three Wire Railway System.—Lond. *Elec.*, March 26.—A note stating that it is proposed to work the projected Brompton and Piccadilly surface railway on the three-wire system with 500 to 600 volts "between the outers" (presumably meaning between each of the outers and the neutral); transmission at 1200 volts was decided upon; the station is 1.75 miles from one of the terminals; it is thought that a good balance could be maintained except during short periods of the day, when balancing transformers distributed along the line will be used; the neutral will be represented by four heavy rails and two iron tubes (the tunnel lining) surrounded by grouting, and it is thought that all danger from electrolytical action should be practically avoided thereby.

Diagonal System of Trolley Wire Support. Henry. *Elec. Eng.*, March 31.—A brief illustrated description of his new method in which only one-fourth of the number of poles ordinarily used is required. The wire is supported from a long bracket at the top of the pole and at one intermediate point between the two brackets by a diagonal wire from the top of one pole to the next. (The proportions in the diagram seem more favorable than those which would exist in practice.)

Steep Grade Line.—Eng. News, March 25.—A report of a committee on the feasibility of operating electric cars on a certain line in St. Paul on which there is a 16 per cent. grade 500 feet long; the commission reports that it would be entirely safe and practicable to run electric cars on this hill.

Electric Power Stations. Lardner. *Wisconsin Engineer*, January.—The principal points to be considered in designing a power station are the power per car, the size and number of units, and the arrangement and coupling of the engines and dynamos; he discusses these for stations operating 5, 25 and 100 cars, using the method of Crosby and Bell, but based on more modern data.

Electric Traction in City Streets. Perry. *Cassier's Mag.*, April.—An article accompanied by a large number of illustrations of roads and cars in this country and abroad, and in which he presents "the status of each of these (electrical) methods in purely disinterested professional circles"; he points out the objections to the underground and sectional systems presenting views which he believes may seem pessimistic.

Electric Railway Track. Camp. *Wisconsin Engineer*, January.—An article in which he points out present tendencies in such track construction.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Automatic Extinction of Lamps.—Lond. *Elec. Rev.*, March 26.—An illustrated description of the switches used in Portsmouth, by means of which incandescent lamps are substituted for arc lights for street lighting after the latter have been extinguished at midnight; this automatic switch is in use on 240 lamp-posts; when the arc lamps are turned off the incandescent lamps are automatically lighted; a number of conditions must be provided for in such a switch, among others that the incandescent lights may be turned off without relighting the arc lights in the mornings, which is accomplished by a reverse current. Another form of switch is described and illustrated for controlling incandescent lamps in buildings; it enables a large switch to be operated from a distance without the expense of running the main wires along the whole distance.

Driving Alternators in Parallel.—Lond. *Elec. Rev.*, March 26.—A short editorial note stating that the new station at Wandsworth two direct-driven alternators were run in parallel with perfect satisfaction, although the engines had only one crank each; the engines are of 300 horse-power each.

Brighton.—Lond. *Elec. Eng.*, March 26.—A reprint of some of the accounts of this station for the past year.

Breaking Circuits. Wurts. *Sibley Jour.*, March.—An abstract of a recent lecture on the handling of electric currents, arcs, etc. After giving briefly the properties of an arc formed on breaking a circuit he discusses various forms of apparatus for breaking circuits, chiefly those made by the Westinghouse Company, which are illustrated. Among other things he points out the good results obtained by the addition of a fine wire shunting a fuse, to prevent arcing; such fuses are in continuous service; the shunt wire is preferably made of German silver; for out-door work where this could not be used the sneezer fuse block was designed; he discusses the subject of switches, especially for high potential circuits, pointing out the danger of a long arc especially on alternating systems, and describes the plunger switch in which the current is gradually reduced by the formation of an arc and the removal of the conducting vapors, the arc being formed in an insulating tube; it interrupts the current with remarkable evenness and smoothness; it can be used up to 50 amperes at 2000 volts, but for higher voltages two or more plungers are connected in series; when the E. M. F. is nearly in phase with the current, the current is always instantly interrupted in this way; as they may not be in phase some of the gaps are shunted with a proper resistance; this is explained at some length; it is used on switches for 2000 amperes at 2000 volts in the Niagara plant. The street car controller is then discussed; a controller should be provided with a series switch which should be closed first before the other contacts of the controller, and it should also be opened first. The Wurts switches are then discussed at some length, accompanied by illustrations.

Isolated Plant.—Jour. Elty, Nov.—A brief illustrated description of what is considered a model plant in a department store in San Francisco, in which a number of conditions were laid down, among which were that all the elevator and power circuits should be operated from 220 volts and the arc and incandescent circuits from independent 110 volt mains; the dynamos were installed in pairs, each pair connected to a separate engine and the bus-bars for the power and light circuits were kept separate.

Arc Light Plant.—Elec. Jour., March 15.—A description with a large number of illustrations of the plant of the West Side Park and Boule-

yard system in Chicago, which is claimed to be a model plant in every respect.

WIRES, WIRING AND CONDUITS.

Aluminium as a Conductor for Cables. O'Gorman. Lond. *Elec.*, March 19. —A reply to the statement of Leeds (see *Digest*, March 20) that when its price was slightly less than double that of copper it would be available as a conductor of electricity. The present writer shows that this would not be the case, but at two-thirds the price of copper it would be used as an electrical conductor and then chiefly in the bare state; the large volume has the effect of increasing the static capacity of cables, which precludes its use for telephony and telegraphy; also to diminish the insulation resistance and to increase the cost of covering more than the price of two cables would be about the same at this ratio.

Carrying Capacity of Cables.—Sibley Jour., March.—A table giving for each of a number of large cables of different sizes, insulated with rubber, and braided or lead covered, the number of amperes for a rise of 30° and 50°C; the cables were tested in still air. Paper insulated cables heat 8 to 10 per cent. more, other conditions being the same; about four hours are required for the final temperature; 60 per cent. of this increase is obtained in the first hour; 30 per cent. in the second and 8 per cent. in the third; cables immersed in water will carry 50 per cent. more current for the same temperature and in moist air 15 per cent. more; copper cables should not be heated above 70°C, and paper cables above 90 per cent. C.

ELECTRO-PHYSICS AND MAGNETISM.

Vacuum Tube Radiation. Precht. *Nature*; noticed in the Lond. *Elec.*, March 26.—A paragraph giving a brief abstract of his recent thesis; he confirms the view that these rays are of a highly complex nature; Rontgen's, Goldstein's and Lenard's rays can be distinguished from those deflected by a magnet, by their chemical and photographic effects; he thinks a portion of the radiation is not a wave motion and he suggests that it may be electric in its nature; interference phenomena were obtained with direct and reflected Rontgen rays and from these their wave lengths were found to range between 370 to 830 multiplied by ten to the minus sixth power mm.; he seems inclined to the theory of longitudinal waves.

Cathode Rays. Elster and Geitel. *L'Eclairage Elec.*, March 20; abstracted from the *Wied. Ann.*, 59, p. 487.—They discuss the residual effect and the photo-electric properties of salts; in repeating the experiments of Goldstein on the change of color of certain salts under the action of cathode rays, they observed a new result; on the wall of the vacuum tube a thin layer was produced resembling a thin film of metallic sodium and it was thought that the chloride of sodium used in the experiment had been decomposed with the liberation of metallic sodium.

Mechanism of the Discharge by Rontgen Rays. Perrin. *L'Eclairage Elec.*, March 13.—A brief discussion of the action of Rontgen rays in discharging electrified bodies with special reference to the actions of the surfaces.

Transparency of Bodies to X-Rays. Van Aubel. *L'Eclairage Elec.*, March 6; abstracted from the *Jour. de Physique*, 5, p. 511.—He compares the diathermacy and the transparency of bodies and of vapors, to X-rays. Among other things he shows that the presence of the halogens and of sulphur in a molecule increases at the same time as the diathermacy and the opacity for X-rays; bodies containing the elements hydrogen, halogen and oxygen allow the rays to pass easily.

Visibility of X-Rays. Brandes and Dorn. *Wied. Ann.*, No. 3; noticed in the Lond. *Elec.*, March 26.—The original paper contains a full account of the experiments. Under favorable circumstances X-rays exert a vague luminous effect upon normal eyes from which the lens has not been removed; the lens, even if affected by cataract, is fairly transparent but the vitreous body is comparatively opaque.

Suggestions for an X-Ray Tube. Spencer. Lond. *Elec.*, March 26.—A short communication in which he gives an illustrated description of a suggestion for keeping the platinum plate cool; he believes the greater efficiency of the focus tubes is due to the fact that the platinum plate may be heated to a higher degree than the glass walls and that the tube could be forced to any extent if this plate be kept cool. In his apparatus the platinum plate is replaced by a small hollow flat vessel of platinum to which two platinum tubes are attached leading to the outside of the bulb; water is then made to circulate through this hollow vessel.

Transparency of Bodies for X-Rays. Benoist. Lond. *Elec.*, March 26.—A brief abstract of the French Physical Society paper which appears to be supplementary to the one noticed in the *Digest*, Feb. 27.

Dielectric Constant of Liquid Oxygen and Air. Fleming and Dewar. Lond. *Elec. Eng.*, March 19.—A reprint, apparently in full, of a Royal Society paper giving and discussing the results of their measurements in which a close approximation to these constants were obtained.

Principles of Alternate Current Working. Hay. Lond. *Elec. Eng.*, March 26.—The conclusion of the long series of articles which has been running through that journal. In this series it has been the aim to explain in as simple and concise a manner as possible the leading principles which govern the practical applications of alternating currents; no attempt has been made to deal with the descriptive and practical aspect of the subject.

Terrestrial Magnetism. Reeves. Lond. *Elec. Eng*, March 26.—A short abstract of a recent Royal Geographical Society paper. He recommends using a common line to which all observations for inclination should be referred and claims that the only natural line to adopt is the geographical axis of the earth; at present inclinations are measured from the plane of the horizon of the locality and this base therefore varies with the locality.

Electro-Magnetic Apparatus. Koenig. *Wied. Ann.*, No. 3; mentioned in the Lond. *Elec.*, March 26.—A description of a small magnetic rotation apparatus in which a bunch of magnetic poles rotates around a current flowing through a tube; the effect of the opposite poles is eliminated by turning them into the interior of the tube.

Magnetism for Engineers.—Lond. *Elec. Rev.*, March 26.—An article intended for engineers, as distinguished from scientists, in which it is endeavored "to elucidate some of those conceptions of a scientific mind which are a frequent cause of bewilderment to the electrical engineer who wishes to extend his knowledge of magnetic matters beyond what is usually considered sufficient for the purposes of dynamo design."

Temperature and Ohmic Resistance of Gases. Trowbridge and Richards. *Am. Jour. of Sc.*, April.—A long, well-illustrated article in which they describe experiments to determine these qualities of gases during an oscillatory electrical discharge; Pluecker tubes were used. By means of the careful method used they found that a mass of gas at low tension contained in a capillary tube may act as though it opposed a resistance of only 5 or 6 ohms to the spark of a large condenser. The conclusions from their experiments are as follows: "The resistance of a gas at low pressure to the oscillatory discharge is equivalent to only a very small ohmic resistance; this resistance is in general greater, the less the quantity of electricity; down to a very small pressure, this resistance decreases with the tension of the gas; the form of the tube has an important effect upon the resistance of the gas; with the oscillatory discharge it is evident that the electrodes produce far less effect than with the continuous discharge." The quantity of electricity going through the tube in a given time with oscillatory and continuous current is almost incredibly different; under the conditions of most of their experiments the spark does not last more than a millionth of a second and hence the current strength at that instant must be about 100 amperes; on the assumption that the departure from Ohm's law is not large they calculate that there will be an amount of energy developed in the tube which is over 10,000 horse-power for the millionth of a second; all the results support the hypothesis that the current when disruptive is carried by dissociated molecules.

Does a Vacuum Conduct Electricity? Trowbridge. *Am. Jour. of Sc.*, April.—A very short article in which he states that some recent experiments led him to believe that the principal resistance resides at the boundary between the rarefied space and the electrodes; in the case of a disrupted discharge after the initial resistance breaks down, the medium exhibits hardly any resistance during the oscillations of the discharge; he discovered that a discharge through a tube at the moment when Rontgen rays were being produced most strongly was an oscillating one of high period, about 10,000,000 oscillations per second; "perfect definition therefore cannot be obtained even with the use of an electrical machine, unless care is taken to shield the anode from the photographic plate." He also discovered that a spark of 6 inches indicates little if any more resistance than a spark of one inch; the sparks therefore do not follow Ohm's law; he believes that the disruptive discharge encounters its chief resistance at the going over layer between the electrodes and the medium; by the method used an increase or diminution of half an ohm could be detected. The resistance of a Crooke's tube to the disrupted discharge seems to diminish with the rarefaction, or the nearer we approach a vacuum.

Induction Coil Methods for X-Rays. Norton and Lawrence. *Science*, March 26; a short article supplementary to the one noticed in the *Digest*, March 6.—They describe some of their experiences with the method of using a condenser discharge in the primary instead of a make and break current; with this method they obtained much better results than with any they had tried. Among other things they stated that reversing the tube for a few moments will again lower the resistance but that this applies only to a focus tube with a platinum anode; the part played by the spark gap is not yet clear; a gap between spheres is better than between points; some tubes will run better without a spark gap, but when it is used it should be on the cathode end of the tube; a proper adjustment of the spark gap may increase the radiations several hundred per cent.; they charge and discharge the condenser 250 times a second and there is no sparking at the commutator except the light spark on making the circuit; the great increase in the results are probably due to the great rapidity of the discharge of the condenser; they believe that the secondary discharge is due to the rise rather than to the fall of the current in the primary.

Tesla Coil for X-Rays. Remy. *Elec. Rev.*, March 31.—A reply to the recent statements by Willyoung, who prefers the induction coil to the Tesla coil; the present writer favors the latter; he admits that there are more parts but claims that they need no particular attention and require only one adjustment; he uses no oil; he believes it to be not any more noisy than the vibrator of an induction coil; he admits that there are two foci but when brought close together this is no advantage except for the very finest work for which only one focus may be used.

Cutting Lines of Force. Kingsland. *Engineering Journal*, Feb.—A short article in which he describes an experiment intended to prove that the theory that E. M. F. is generated by cutting lines of force is not correct, as distinguished from the theory that the induction is due to the change in the number of lines passing through the circuit. He gives an illustrated description of a sort of unipolar machine which on trial gave no current and he bases his conclusions on this. (The assumption which he makes in explaining the action of the machine is incorrect and he makes the same error which has frequently been pointed out and has been made by many others in designing inoperative unipolar machines. He assumes that the portions of the armature coils can be shielded from inductive action by means of an iron shield surrounding them, which shield also cuts the lines of force; as is now well-known such a "shield" will not act in this way; his conclusions which involve this assumption are therefore incorrect).

Resistivity of Bismuth at Low Temperatures and in Magnetic Fields.

DEWAR and FLEMING. *El'ty*, March 31.—A reprint of the paper noticed in the *Digest* March 27.

Recovery of Gold from Cyanide Liquors.—Lond. *Elec.*, March 26.—A brief description of the improved method of Andreoli. The gold is deposited electrolytically but by a different method than the usual one; the anodes are plates of lead covered with lead peroxide produced by the Plante formation; the cathodes are plain iron plates and are stripped of their gold by being dipped into molten lead, the surface of which is covered with powdered charcoal to prevent oxidation; the cathodes are thus almost permanent and the gold is obtained in the convenient form of a solution in lead; the probable life of the peroxide plates is an important factor; it is stated, however, that such plates have been in use for some months without appreciable depreciation.

Test of a Guelcher Accumulator. PEUKERT. *Elek. Zeit.*, March 18.—The results in detail of a recent test of this accumulator followed by a table containing the capacity per kg of eight different types of European accumulators for different rates of discharge, by way of comparison; this table shows that the capacity per kg of total weight of this cell was almost 100 per cent. greater than the best of the others and very much greater than most of them; for a one hour discharge it was 3 ampere hours per kg and for a 10 hour discharge 6.5; the efficiency was somewhat lower but this is not thought to be of great importance; the accumulator is shown to have behaved very well under rapid discharge. The plates, as was described in the *Digest* some time ago, consist of a sort of woven fabric of lead wires and glass wool; into this fabric the active material is then made to penetrate by a special process. The total weight of the cell was 6.3 kg and it was claimed to have a capacity of 37 a.h. at a 6-hour rate and 45 at a 12-hour rate.

Theory of Lead Accumulators. LIEBENOW. Lond. *Elec. Rev.*, March 19.—A brief abstract of the theory which he recently advanced, (see *Digest* Feb. 8 and July 18, 1896, also Nov. 21); he makes and proves the assumption that there are negative peroxides of lead irons.

Production of Metallic Alloys. WALTER. *Zeit. f. Elektrochemie*, March 5.—An article in which he reprints the greater part of an application for patent made ten years ago, which at that time was refused. It is for making alloys among the metals and with the metaloids phosphorous, silicon, or boron.

Influence of Magnetism upon the E.M.F. BUCHERER. *L'Eclairage Elec.*, March 6; abstracted from the *Wied. Ann.* 58, p. 564.—A discussion of the disagreement between Hurmuzescu and Duhem. This is followed by an abstract of a supplementary paper from the *Wied Ann.*, 59, p. 735, which latter is largely mathematical in nature.

Electrolytic Preparation of a New Class of Oxidizing Substances. CONSTAM and VON HANSOM. Lond. *Elec. Rev.*, March 19.—An abstract of the article noticed in the *Digest* Oct. 31.

Simple Electrical Furnace.—Lond. *Elec.*, March 19.—A translation in abstract with illustration of the article noticed in the *Digest* March 6.

Classification of Galvanometers. FITZGERALD. Lond. *Elec.*, March 26.—Notes from his recent lecture in which he gives a brief description of a method of classification. The first division is into three general classes according as the force is exerted by a current on the magnet, a current on soft iron, or a current on a current; these are further subdivided into those with a rotational deflection and those with a translational deflection; the first two are again subdivided into those with a fixed current and those with a movable current; there are thus ten classes of galvanometers according to the magnetic action; these are then subdivided according to the controlling action; the most important of these latter subdivisions are: Magnetic control, elastic control, gravity control, and inertia control. Each of these divisions and subdivisions is indicated by a specific kind of letter or number, such that the class to which a galvanometer belongs may be indicated by a combination of these numbers or letters.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Cable Currents During a Conductor Test. CHRISTOPHERSEN. Lond. *Elec.*, March 26.—A brief communication concerning a method for finding the E. M. F. of an earth current during an ordinary copper resistance test; he gives Mance's formula which he considers the best; when testing a broken cable it seems impossible to obtain any method for determining the polarization during the course of electrolysis, but for keeping a record of the combined earth and polarization currents accompanying the test for localizing a break, he recommends the following method: Suppose the localization to be taken to false zero; note the deflections and the shunts used; afterwards the value of any cable current can be determined by substituting a rheostat for the cable, unplug a resistance in the bridge equal to that measured at the time in question, insert the same galvanometer shunt as before, apply the battery with the same pole as before, and vary the resistance of the substituted rheostat until the deflection is the same as that at the resistance test during localization.

Observations with the Wimshurst Machine. NEGREANU. *L'Eclairage Elec.*, Mar. 6; abstracted from a Roman journal.—He made a careful study in detail of the way in which such a machine operates; this may be done in the dark, the kind of electricity on the discs or collectors being determined by a metallic point from which needle shaped discharges will be obtained in the regions which are negatively electrified and luminous points in those charged positively. He then describes the observations which he made and which suggested an improvement consisting in the addition of two comb collectors, after which the machine operated equally well in whichever direction it was rotated.

Calibrating Watt Meters. BEDELL. *Sibley Jour.*, March.—Instructions for students' experiments, describing wattmeters and recording wattmeters, together with methods for calibrating them. Among other things attention is called to the two methods of connecting the wattmeter and the position of the multiplying coil placed in series with a shunt coil to multiply the reading for high potentials; this multiplier should be connected to the main which does not pass through the wattmeter in order that two great potentials do not exist in the instrument; when a small transformer is used to reduce the voltage, a balancing wire should connect the secondary with the series coil for the same reason.

Synchronous Motor for Determining Frequency. MOLER. *Sibley Jour.*, Mar.—A short description, without the illustration, of the device mentioned in the *Digest*, Mar. 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

German-Norwegian Cable. PETERSEN. Lond. *Elec. Rev.*, March 26.—translated from the *Telegrafbladat.*—A short article on this cable showing the method used for eliminating the induction, described recently by Dresing and Gulstad.

The Condenser as a Static Compensator. MAVER. *Teleg. Age.*, April 1.—A short article in which he discusses the theory of the action of the condenser as a static compensator in duplex telegraphy, this being a sort of a continuation of a previously published article, illustrating by means of diagrams the assumed effects of the line and static discharges on the relay of the bridge wire when the bridge arrangement is used

Telephony. WIETLISBACH. *Elec. Eng'ing*, April.—A continuation at great length, about 100 pages, of his long serial which has been running through that journal, being a sort of treatise on telephony. The same number contains a short article by the same author on telephone cables and on the air-drying process for such cables; also a few short articles by authors on opposition telephone companies.

Rapid Cable. DEARLOVE. *Teleg. Age.*, April 1.—A reprint of the article noticed in the *Digest* March 20.

Submarine Telegraphy. AYRTON. *Elec. Jour.*, March 15.—An abstract of the paper noticed in the *Digest* March 6.

MISCELLANEOUS.

Wetherill's Magnetic Separator—Zeit. f. Elektrochemie, March 5.—A long well-illustrated description of this separator, which is in use at Franklin, N. J.

Magnetic Metal Extraction.—Sc. Am., March 27.—A brief though not very clear description of the Edison plant at the Franklin furnace. It appears that there are three sets of magnets, the first comprising 74 and the second and third 320 magnets each; the magnets are about four feet long and the ore is said to pass a mile of faces of magnets; it appears that the ore flows past the magnets, the magnetic ore being deflected from its course as in his original separator.

High Conductivity Cast Copper. CHANNING. *Eng. and Min. Jour.*, March 27.—A short communication in which he expresses as his conviction that the prejudice against cast copper is due to the fact that impure metal is used; poor conductivity cast metal will be found to contain oxide of copper; very good results were obtained when the molten metal was protected from the action of the air; he believes that any one can make as good copper as the "M. B." brand if they will cast direct from the refining furnace and take care to make as few cold sets as possible, in their casting.

Application of Electricity to Bank Burglary. RODMAN. *Amer. Elec.*, March.—An account in detail of experiments made to determine the vulnerability of safes by electric means of attack. The method described consists in attaching one wire connected to a 110 to 220 volt system to the safe, and connecting the other lead to the end of a carbon rod which enters a hole in an "oven" of the same diameter as the carbon, the oven being in the form of a hollow box lined with fire clay or asbestos and held up against the safe; using a wooden or other insulating handle to manipulate the carbon, it is approached to the safe until an arc is formed, by means of which a temperature of 9000 to 10,000 degrees is produced, readily fusing the metal of the safe in three to five minutes; a resistance in the circuit brings the voltage down to about 60; the ampereage may be from 150 to 350. The conclusion of the writer is that this method reduces all safes as built to-day, no matter how made, to the same level of insecurity.

Heating Dwelling Houses.—Eng. News., March 25.—A note stating that dwelling houses in Lewiston, Me., the power being obtained from a water fall; power is to be furnished at not less than $36.00 per horse-power by the year; a 10-room house can be heated with 3 horse-power the year around.

Platinum. BAKER. *El'ty* and *Elec. Rev.*, March 24; *Elec. Eng.*, March 31.—An article on the supply and consumption of this metal including an illustrated description of a large nugget weighing two pounds.

Epoch-Making Events in Electricity. STOCKBRIDGE. *Eng. Mag.*, April.—The first of a series of articles in which he discusses in a popular way three of the epoch-making discoveries in electricity and magnetism, with special reference to the literary records through which the knowledge of them was first published; the present one deals with the discovery of volta.

Electrical Bureau of the National Fire Underwriters.—West. Elec., April 3.—A brief illustrated description of the well-equipped laboratory in Chicago supported by the insurance interests.

Index of Engineering Literature. PERRINE. *Engineering Journal*, Feb.—A short article in which he outlines a practical scheme for publishing a card index of engineering literature. It envolves some novel and interesting suggestions, some of which will doubtless aid in making such an index possible.

Magnetic Concentrating Practice. NITZE. *Jour Frank Inst.*, April.—A reprint of a short paper in which he gives an illustrated description of the Wetherill process for separating minerals and chemical substances of very feeble magnetic permeability and heretofore generally consid-

ered as non-magnetic; this includes almost all of the minerals containing iron and manganese, as also chemical salts of these metals. The general principle is to have a very powerful field in a small air gap through which the finely pulverized material is passed on a traveling belt in such a way that a very slight attracting force will cause the magnetic material to adhere slightly to the moving belt while the non-magnetic material falls off freely. Some of the actual results obtained with different ores are given.

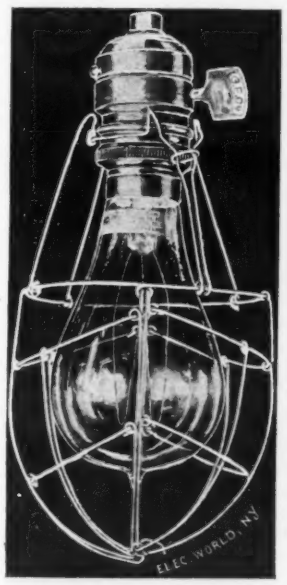
Blow Pipe Furnace. PATTEN. *Elec. Eng.*, March 31.—A brief illustrated description taken apparently from the patent specifications; the principle is that there are a number of arcs in parallel between rods and a common carbon base over which the material moves; these arcs are made to traverse back and forth by means of magnets which deflect them in alternately opposite directions.

Burglarizing Safes by Electric Heat.—Elec. Eng., March 31.—An article consisting mainly of a discussion of the subject by Mailloux, in which he shows that the limitations are such as to make the possibilities of this method much more limited than might at first be supposed. Several other arguments to the same affect are given and are thought to throw entire discredit on the whole idea. Editorially it is concluded that no fear need be had by bankers and others, and it is intimated that the sensational reports have been resorted to in order to advertise a new system of electrical protection.

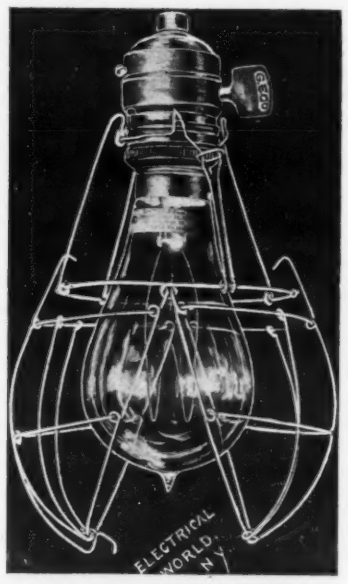
A Simple Lamp Guard.

When incandescent lights are used in places where they are liable to come into contact with solid bodies, or where they must be moved from place to place, the fragile character of the lamp itself requires that it should be protected with some device to prevent its fracture. A very simple arrangement for this purpose is illustrated herewith.

This duplex lamp guard is manufactured by H. M. Underwood & Co., Chicago, and contains some peculiarities of arrangement worthy of note. The lamp may be put in place in the socket or taken out, with the guard in position, by opening the latter, as is well represented in the



LAMP GUARD—CLOSED.



LAMP GUARD—OPEN.

illustrations. When the guard is closed, the two sides lock together by a simple spring clamp, making a very rigid and solid joint. The usefulness of this little device will be greatly appreciated by those who have had to use bare lamps in exposed places.

A Single-Phase Alternating-Current Fan Motor.

The increasing demand for fan motors operated on single-phase current, and possessing the noiseless and reliable features of the best class of direct-current motors, has led to the design of the motor illustrated herewith.

The Wagner Electric Manufacturing Company, St. Louis, Mo., has just introduced this new type of ceiling fan. The motor is of the induction pattern, without commutator, collector rings or brushes. The primary and secondary windings are entirely separate from each other, the primary, constituting the stationary element, being formed of a single coil. This has such a liberal carrying capacity that it is practically safe from burning out, whether the motor be running or standing still. The secondary or revolving element is of the familiar "squirrel-cage" type, and its arrangement is such that its electrical injury is impossible. The mechanical construction is extremely simple. The driving force operating directly upon the main shaft, there is no combination of noisy and troublesome speed-reduction devices.

The sectional view illustrates the mechanical construction better than any description. The method of suspension and lubrication is excellently adapted to this class of work, and a single filling of the oil chamber is sufficient for a year's operation.

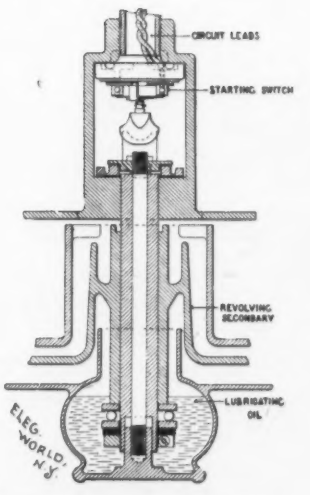
The motors are constructed for frequencies of 60 and 133 cycles per second, and either type can be operated at voltages of either 110 or 55. A speed regulating device of great simplicity is included in each motor.

ALTERNATING-CURRENT FAN MOTOR.

At 125 revolutions per minute the energy consumed by a ceiling fan of this type is 125 watts. The starting switch is mounted upon the motor, and a simple turning of a projecting lower part of the case is all that is necessary for its operation.

Arc Lamp.

The Paragon Arc Lamp Company, Boston, Mass., has just placed on the market a long-burning arc lamp for either a 6.8 or 9.6 ampere series circuit. This lamp burns 100 hours without attention. As there is no resistance there is no waste of energy, which is a consequence of the use of such energy-wasting devices. It is stated that the lamp will burn throughout the entire life of the carbons and operate satisfactorily on



CROSS SECTION OF FAN MOTOR.

ARC LAMP.

any of the standard types of arc machines. One of the chief features of the lamp is an automatic cut-out, which does its work quickly and effectually should the lamp receive, from any cause, an excess of voltage. This obviates any liability of burning out the coils.

The Paragon Arc Company states that it is meeting with gratifying results with this lamp and anticipates a large business during the coming season.

New High-Pressure Steam Separator.

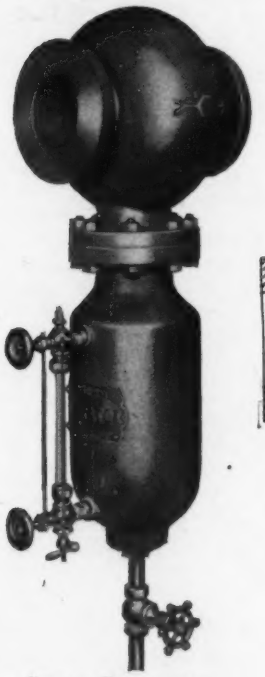
A new form of Cochrane steam separator for horizontal pipes has been produced by the Harrison Safety Boiler Works, Philadelphia, Pa., illustrations of which are presented herewith.

This separator is designed for high-pressure service, and embodies the same principles that are found in previous forms, and which have proven so efficient in separating oil from steam. It is of the baffle-plate type, with a steam passageway on each side of the baffle, the drainage to the well being direct and by gravity, and the water or oil deposited in the well being properly protected from the current of steam.

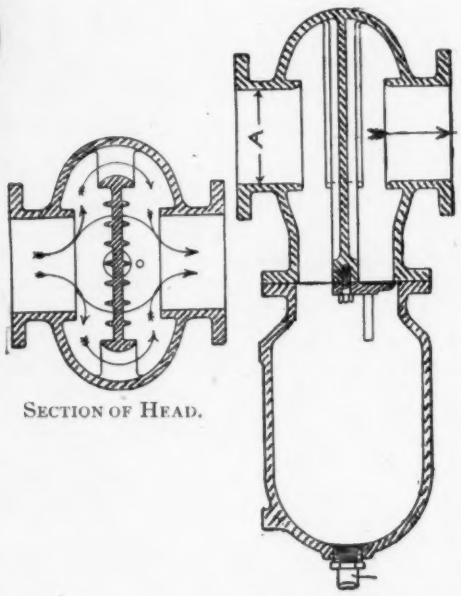
The shape of the upper part of the head in the new design, where separation is effected, is similar to that of an oblate or flattened sphere, with branches projecting from each side parallel to the minor axis, for carrying the incoming and outgoing current, and with a branch from the bottom of the head for the well connection.

The baffle-plate, which is cast as part of the head, is corrugated on both surfaces, and has ports or passageways for the steam on each side. The lower sills of these ports are so placed as to prevent water being carried past the separator, should the well become filled up, until the water taken out reaches the level of the bottom of the pipe.

The chamber on the inlet side of the head is in direct communication with the well, while that on the outlet side is isolated from the well by a plate, which closes one-half of the opening between the head and the well. A small pipe inserted in this plate drains away any condensation in the outlet chamber and destroys the cushioning effect of steam in the well.



Steam Separator.



Section of Head. Vertical Section.

The separators are made in standard sizes for any working pressure from 200 pounds per square inch or under.

Where it is desired to carry a large quantity of steam close to an engine, because of small supply pipes, or sudden variations of load, or of vibration due to quick cut-off, the use of a large steam receiver instead of the standard well is recommended.

The purpose of this receiver being to act as a storage tank of dry steam, or as a cushion to take up the rebound when the flow of steam is suddenly stopped, it is necessary that it should be freely open to the supply pipe running to engine. To accomplish this, the plate closing off the chamber on the outlet side is transferred over to the inlet side, and a large drain pipe running down to the bottom of the receiver is inserted in this plate. This prevents any water from being "whip-snapped" under the baffle.

The drainage of these receivers is effected by any of the methods used in connection with the standard separators.

Electric Haulage in a Mine.

The Woodward mine of the Delaware, Lackawanna & Western Railway, at Kingston, Pa., is about to be equipped with electric haulage by the General Electric Company.

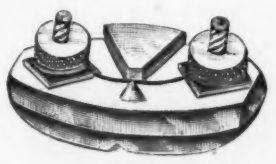
The generating plant will consist of one 165 kw dynamo, directly connected to an American Ball engine. The circuits will be three in number. The first will pass down a vertical shaft 725 feet deep, and will operate one 10-ton locomotive in the Cooper vein. The two others will be carried down another vertical shaft, 1026 feet deep, to operate two 10-ton locomotives in the Red Ash and Baltimore veins. These locomotives will be equipped with two 40 hp G. E. motors, and will handle trips of loaded mine cars, each loaded car weighing about four and one-half tons.

It is estimated that this installation will show in operation a net saving of 29.5 per cent. over mule haulage, including a large reserve for depreciation, interest and fixed charges. The total output of these three locomotives will be about 3800 tons per day, and the total length of trolley wire in the gangway will shortly reach four and a half miles.

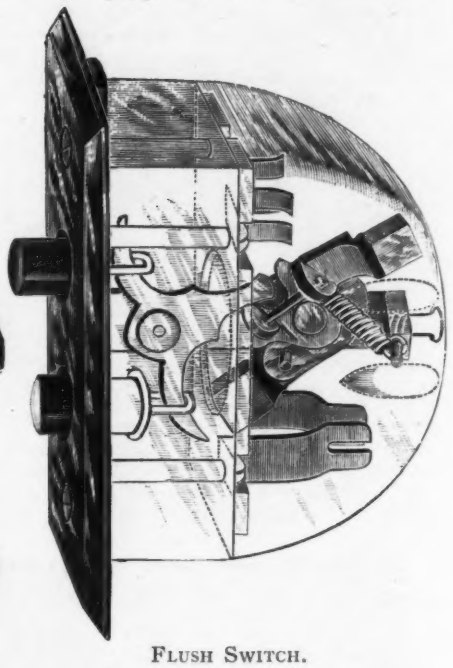
Bug Cut-Outs and Flush Switches.

If bug cut-outs continue to grow smaller, it will not be long before a microscope will be required to see them. Among the latest turned out in this direction is that shown in the illustration. It has recently been put upon the market by the Newton Appliance Company, 120 Liberty Street, New York.

Bug Cover.



Bug.

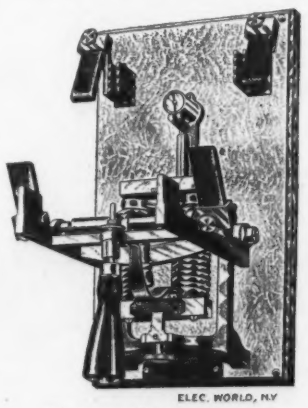


Flush Switch.

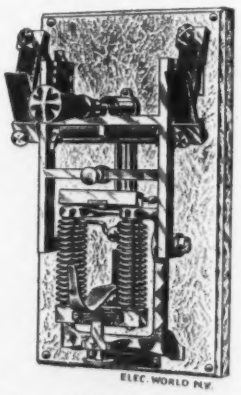
The flush switch also illustrated is the invention of Mr. W. J. Newton. The movement of the switch is an entirely new one, and we understand it is amply covered by patents. The switch has met with hearty approval at the hands of the trade and its prospects seem very bright. The points of special excellence claimed for it are its reliability and simplicity.

Automatic Circuit Breaker.

The unfortunate experience which many station managers and others engaged in electrical pursuits have had with fuses at times of sudden emergency have led to a gradual increase in the use of magnetic devices for circuit breaking. The fuse which will blow and open the circuit under a steadily rising load frequently fails to operate with sufficient quickness when a heavy short-circuit, or lightning, sends an enormous rush of current over the line it is supposed to protect. For a long time there has been an urgent need for a reliable, simple and effective magnetic circuit breaker, and this has led the Automatic Circuit Breaker Company, Newaygo, Mich., to place upon the market the improved forms of these instruments here illustrated.



Circuit Breaker, Open.



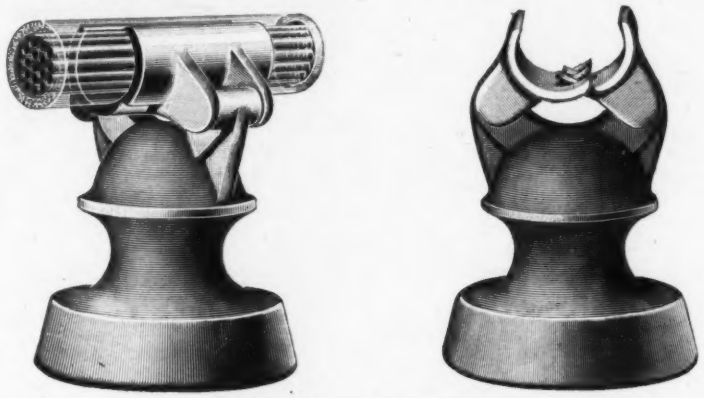
Circuit Breaker, Closed.

In these instruments the moving switch part is thrown out by a sudden hammer blow delivered upon the stem of the handle by a spring in the dash-pot, which is well seen in the illustration. The instrument contains no other springs whatever, the armature being returned to its position after operation by a weight. A graduated scale is provided with an adjusting screw, the graduations being made in amperes, and the instruments are said to work within 1 per cent. of their set capacity. These instruments have been in use upon various systems and voltages for some time and have already gained considerable success.

A Toggle-Clamp Feed Wire Insulator.

Any improvement which will facilitate the attachment of the feed wires to their insulators will be appreciated by the electric railway builders. The fact that much stronger insulators with mechanical and more or less adjustable means for fastening the wire have come into existence during the last few years evidences the demand for such devices, and any improvements which will do away with the present necessity for tie-wires, screw-caps and other time-consuming methods of fastening, will be truly valuable as leading in the direction of greater speed in construction and ultimate economy.

The "H. W. J." Toggle-Clamp embodies the modern improvements in this direction. The fastening is effected by a clamp constructed on the principle of the toggle lever. The jaws of the clamp are hinged so that they tend to separate when raised for the reception of the cable. The weight of the cable when released then furnishes the force which causes the clamp to grasp the wire; for as the cable descends to its seat, its



TOGGLE-CLAMP INSULATOR.

weight tends to close the jaws, and the greater the weight the more powerful will be the action of the clamp and of its hold upon the wire.

The operation of the device is very simple. To attach the wire to its insulator it is only necessary to raise the jaws sufficiently to drop the wire into place. The clamping effect is entirely automatic and very powerful, and no other fastenings whatever are necessary. An ample seat for the wire is furnished by the long jaws, thus materially reducing the wear and tear upon the cable. The cable may be instantly removed by lifting it out of the insulator, while the ease and rapidity with which the wire may be attached and detached, without damage to either insulator or wire, are valuable economical features.

This clamp is being introduced by the H. W. Johns Manufacturing Company, New York City, whose ironclad feed wire and other insulators have become well known to constructing railway engineers. It has preserved the ironclad feature in the Toggle-Clamp insulators in view of the great strength and durability obtained with the metal-clad construction.

Motor for Heavy Railway Service.

Steam versus electricity being the subject of debate of engineering societies at the present time, the actual substitution of electricity for steam as a motive power on suburban and elevated roads is assuming large proportions. Already suburban branches of steam roads and

RAILWAY MOTOR.

two elevated roads are operated entirely by electricity, and the General Electric Company, in anticipation of this new phase of electric railway work, has designed and developed, and is to-day prepared to furnish, every kind of apparatus for the complete electrical equipment of suburban railways now using steam.

The G. E. 51 railway motor has been especially designed for high speed suburban and elevated railway work. It has a capacity of 80 hp, rated according to the standard basis of a rise of 75 degrees Centigrade above the temperature of the surrounding air, after a run of one hour at rated load.

A large number of gear reduction combinations may be used to afford a wide range of speed and tractive effort. For high speed work a gear reduction of 1 to 1.74 is used, and at the present time trains of 25 to 30 tons, equipped, with two G. E. 51 motors, having this gear reduction, are operated at speeds of from 45 to 50 miles an hour with success.

The G. E. 51 motor may be readily adapted to slow speed work, snowplows, freight locomotives and the like, by the use of larger gear reductions, and the electric brake may be satisfactorily added to the G. E. 51 motor equipments. The G. E. 51 two-motor equipment, with the electric brake, includes the B 7 brake controller, and without brakes the ordinary K 13 controller.

In general appearance the G. E. 51 motor resembles the G. E. 1000. The field frame is two steel castings, parted horizontally, but extended to the back to envelop the car axle. A large opening is provided, allowing easy access to the motor for the adjustment of the brushes and the inspection of the interior. An important and novel feature of the motor appears in the bearings. The large size axle bearings are lubricated by the use of oil, and wool waste is packed in the oil reservoir underneath. The armature bearings are lubricated in like manner, and all the bearings are essentially similar to those designed for steam railroad service according to Master Car Builders' specifications. An especial feature of the armature bearing is the adjustment—the armature being raised and lowered by set screws at the top and bottom of the armature bearings.

The armature construction is the standard adopted in all the G. E. motors. It is of the drum-wound, iron-clad type, with machine-wound interchangeable armature coils.

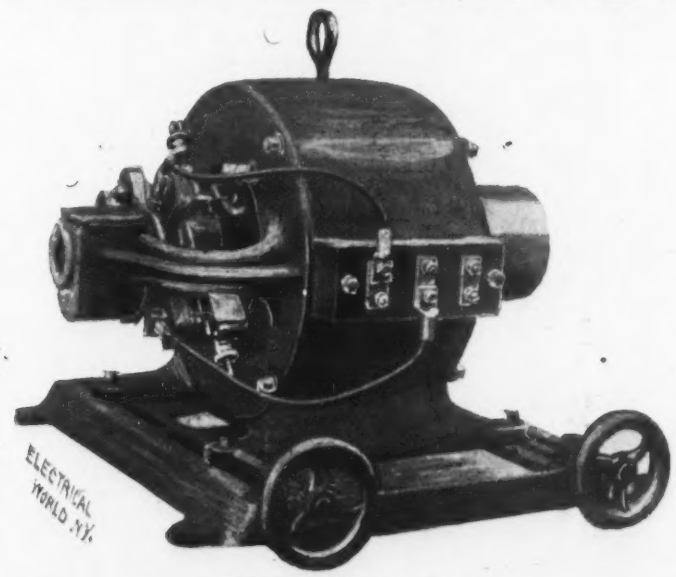
The commutator is manufactured from the best hard-drawn lake copper, the segments being 1¼-inch in depth to allow of considerable wear before refilling is necessary. There is a groove encircling the commutator near the end, leads to facilitate their removal.

The brush-holders are of the standard type, each holder containing two brushes, and to prevent ridges forming on the commutator, these are staggered.

Ironclad Multipolar Motors and Generators.

The gradual evolution and development of dynamo electric apparatus has resulted in the perfection of certain types of these machines adapted for slow speeds or to be directly connected to driven machinery, and so designed that their exterior parts afford a permanent and complete protection to their inner mechanisms.

The type of machine which we illustrate herewith is a four-pole ironclad generator, manufactured by the Central Electric & Foundry Company, Lewisburg, Pa. The fields and supports for the bearings are cast in one piece, insuring great accuracy of alignment and solidity. The poles are of the salient type, cast integrally with the fields, and owing to the high quality of the material employed, possess very great permeability, thus adding to the efficient operation of the machine. The bearings and the heads are in one piece and may be rotated with relation to the field, so that the machine may be fastened to a floor, wall, or ceiling, and operate equally well in any of these positions. The bearings are of bronze, self-oiling and self-aligning, and are provided with gauges and cocks. The field coils are wound on solid spools which are removable and replaceable with the minimum delay. The armature is a Gramme ring type, of large external diameter, wound with



IRONCLAD GENERATOR.

machine made coils which can be very easily replaced in case of accident. The winding is so arranged that the central aperture of the armature is not filled up, and in this way its radiating surface is considerably increased.

Each of these machines is subjected to a continuous overload of about 25 per cent. for several hours on its factory test. They are manufactured in various sizes from 1½ to 10 horse-power, the speeds varying between 1200 and 975 revolutions per minute, respectively.

New Telephones.

That progress is made in the direction of improvements and new applications rather than in discoveries is shown in the fact that new uses for existing electrical apparatus are found almost daily. The telephone is an instrument that seems to be unlimited in its application, and railway managers will no doubt be interested to know that busy men are finding new ways to facilitate street railway operations by its aid.

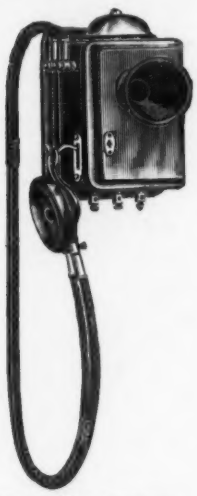
The Garl Electric Company, Akron, O., manufactures a street-car telephone that possesses some commendable features. It is especially useful in the event of break-downs or accident of any nature along the line, and by its use the conductor is enabled to notify headquarters of the trouble and its location.

The instrument is compact and weighs eight pounds. It can be furnished in any style of wood, and is provided with a hand-strap and holder, so that it may be carried around. Ordinarily, however, it hangs on a backboard fastened inside the car.

The generator is wound to work through 30,000 ohms resistance. The diaphragm is of metal, against which a platinum electrode bears. The second electrode is of carbon, and granulated carbon is placed between the two. This method of construction reduces the resistance to a minimum, and requires less battery power for the operation of the instrument. The induction coil is wound to high resistance, and the hook, being of special construction, holds the receiver rigidly, preventing it from being shaken from its position.

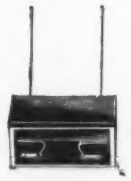
Connecting boxes are located on the line poles, and where side-pole construction is used, and the track is in the middle of the road, hooks are provided on the span wires, which enable the conductor to make connection from the car. The telephones can be easily connected from the platform of a car by means of a hand-pole having a flexible cord passing through it from the instrument and fastened to two spring-hooks on the end of the pole. In case the car is disabled at some point distant from a connection box or hook, the telephone can be taken from the car and carried to the nearest box or hook for the purpose of effecting connection.

The company claims that by its system the telephones are protected from lightning and heavy currents.



Interior Telephone.

Car Telephone and Pole.



Connecting Box.

The hotel and factory telephone made by the same company is neat and compact, and one of the most serviceable instruments on the market for interior work. The diaphragms of the transmitter are made in the same manner as those in the street-car telephone.

This instrument can be connected to any local exchange system as well as used for intercommunication between different parts of the building. This service is accomplished by the use of the company's connecting board. It is stated that only five cells of battery are needed to operate fifty telephones of this kind.

Electricity Direct from Heat.

On March 30 a patent was issued to Mr. S. V. Essick, of Yonkers, N. Y., for a heat battery which possesses some features of special interest at this time, when the problem of obtaining electricity direct from coal is attracting extraordinary attention.

Mr. Essick has at his works one of these devices that occupies a space not exceeding one cubic foot. From this he claims to get an output of 75 watts. Each of the 5 cells, he states, generates a current of 15 amperes, at a pressure of one volt, and to increase the output it is only necessary to enlarge the cells.

The new generator consists of an outer conducting case, ordinarily of copper; a more positive metal, suspended therein; an electrolyte of water and sulphate of copper; a means of feeding a salt of copper, and a source of external heat. It is stated that only sufficient heat is necessary to raise the liquid in the cell to 180 degrees F., after which a very small amount of heat will maintain the temperature at that point.

The theory of the inventor is that he obtains the results claimed because he supplies externally the heat that would be produced by the electrolyte acting on the positive element, and thereby supplements the chemicals in sending out a current. No polarization takes place in the cell, this action being prevented both by the heat and by the deposit of pure copper on the copper elements. The internal resistance of the battery is reduced materially by the heat, thereby increasing the output in accordance with Ohm's law. The form of the cell, by means of which the positive and negative elements are brought close together, aids in reducing the resistance, and conversely increases the current.

Several of these cells exhibited by the inventor, it is stated, developed an output of 38 amperes.

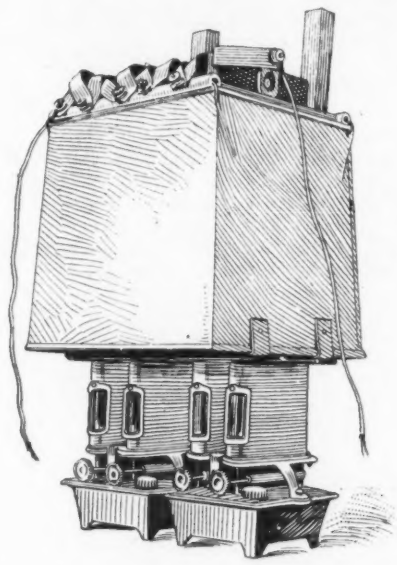
Applications are pending in the Patent Office covering many modifications and details of the device, and European patents are being simultaneously secured. It is Mr. Essick's intention to place the heat battery on the market at once. His office is at room 1326, American Tract Society Building, 150 Nassau Street, New York City.

Street Railway Lamps.

Some new incandescent lamps for street railway service are offered to street railway companies by the Columbia Incandescent Lamp Company, St. Louis, Mo. These lamps are of three types, one having a double coil filament, unanchored; the second having the filament anchored, and the third having a round bulb, which is well suited for headlights and decorative lighting. In the unanchored filament lamp it is stated that the filaments do not droop and come in contact with the glass, and the light given is excellent.

The round bulb lamp is in use on many railways for headlights, and is made to consume the same amount of energy as the lamps in the car, so that it may be used in series with the latter. These lamps are also suitable for decorative illumination in cars, and are furnished either plain, frosted or colored. Some very handsome effects can be produced by their use, and they are popular with trolley parties.

All of these lamps are made to consume the same amount of energy,



Heat Battery.

Unanchored Filament.

burning in series, and the Columbia Incandescent Lamp Company guarantees them to be of the highest quality and to give the most satisfactory service as to maintenance, candle-power and length of life. It is stated that they give a uniform distribution of light.

These lamps are made with standard bases, and attain in every particular the high standard of excellence established by the company.

New Alternating-Current Fan Motor.

The Westinghouse Electric & Manufacturing Company has succeeded in constructing an alternating-current fan motor for the season of 1897 that by its many advantages of construction and operation will bid fair to become one of the most popular fan-motors of the coming season.

The machine is of the induction type and differs somewhat from the mechanical proportions of the fan motors of recent years in being smaller and lighter. It retains the feature that was introduced in the Westinghouse fan motor of last year and which was found of great practical value, that is, "speed variable at will," which is effected by the use of a three-contact switch, of simple construction, located in the base of the motor. By means of this switch the motor may be run at full speed, at moderate speed, or it may be cut out of the circuit.

When the motor is running at full speed the breeze of air supplied is strong, steady and of wide range. When running at moderate speed the motor successfully meets the requirements of the best desk fan, the breeze being considerably reduced and the current required to drive it being materially less. The motor is especially useful in a sick room or a bedroom at night, securing effective circulation of air and operating almost without noise.

This fan motor has neither a commutator nor brushes, and weighs complete, ready for service, twenty-five pounds.

Experimental Heavy Railway Work with Electric Locomotives.

The trend taken by the electric railway industry in the direction of the field hitherto occupied exclusively by the steam locomotive, as evinced by the recent developments on the New York, New Haven & Hartford and Baltimore & Ohio railroads, has caused the General Electric Company to provide itself with its own special line of track upon which to carry out electric traction experiments.

The line of track lies between the works at Schenectady and the

FIG. 1.—TRAIN AT REST.

Erie Canal. It has been laid upon the heel path, is 6700 feet long, and is of the regulation New York Central Railroad construction, the service rails being standard rails, 85 pounds to the yard. It is upon this track that almost daily equipments are tried under different steam road conditions and bursts of speed made and efficiencies recorded of a more than encouraging nature.

Running beside the track, on the far side from the canal, are the conductor rails. Of these there are two, running parallel with each other and the track, from the top of the first gradient to the end of the line. They are 30-pound rails, set on eight-inch ash blocks, treated with bergtheer in vacuum pans and thoroughly impregnated. The two sets of conductor rails have been laid down for the purpose of experimenting with alternating multiphase currents. For direct current

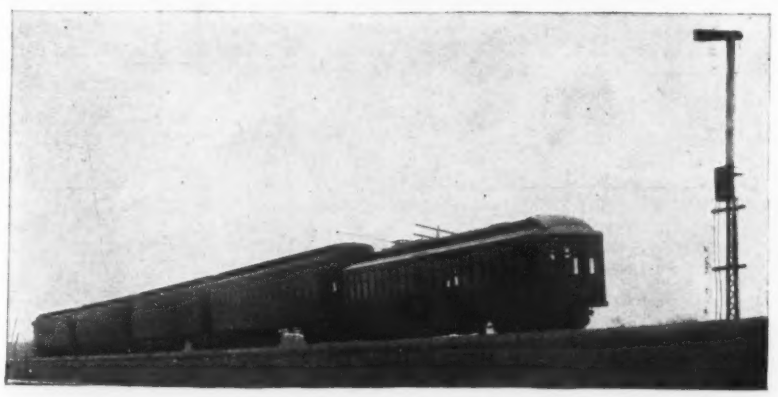


FIG. 2.—FORTY MILES AN HOUR.

experiments the two rails are connected in multiple. Both service and conductor rails are bonded with 0000 copper bonds.

The current is taken from the works power house, over a line issuing from the back of the testing department. The feeder is a 500.000 c. m. insulated cable, running by the track for a distance of about 5300 feet. The line is divided into three working sections, each controlled by its own switch and semaphore. When this switch is closed, its section of conductor is made alive, and the movement of the switch handle sets the semaphore.

The experiments made so far have been carried on for the purpose of developing motors and systems of operation for elevated and surface steam roads. For locomotive a special eight-wheeled car is used. This resembles a regular passenger coach, so constructed as to give an unobstructed access to the two motor trucks. The weight of this coach-locomotive, equipped, is about 30 tons, empty. It is divided into three sections—a driving and testing department in front; a passenger division in the centre, and a rear compartment, in which are carried the air pump, tools, etc.

The equipment of the forward compartment consists of a skeleton wooden switchboard, carrying the ammeters, voltmeters, wattmeters, quick-break switches, magnetic blow-out, fuse boxes, automatic circuit-breakers, etc.

In the test during which were taken the photographs from which our illustrations were made, the equipment of the car consisted of four G. E. 2000 motors—each motor being rated at about 125 hp—one motor to each axle, motion being communicated to the wheels through steel gear and pinion. The forward truck was equipped with a special speed recorder. The controller used was a K 16 series parallel controller. From beneath the bolster of each truck set between the wheels on the conductor rails side, projects a heavy oaken beam, to which is suspended the contact shoe.

The air for the brakes and whistle, one of which is set at each end of the car, is furnished by a vertical direct-connected air pump, operated by a motor controlled automatically.

The first test made with the motor equipment, the total drawbar pull of which is about 15,000 pounds, consisted in the hauling of four flat cars, each loaded with pigs of iron. This load, about 121 tons dead weight, was easily handled by the locomotive, and the records as to speed and power required, it is stated, showed most gratifying results.

The locomotive was then coupled to four New York Central standard passenger coaches, making with the motor car a train of 130 tons. Several interesting runs were made with this train up and down the track, with equally encouraging results.

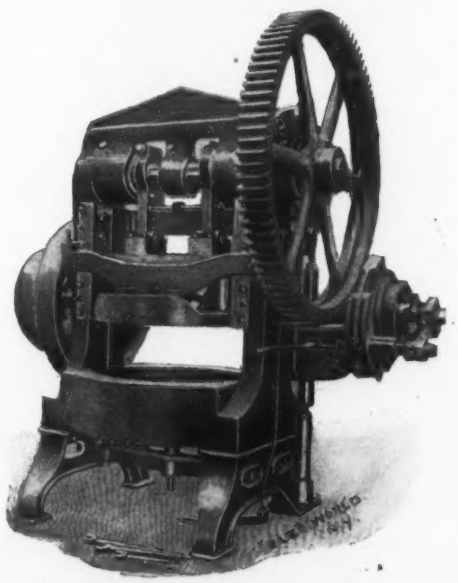
Our illustration (Fig 2) of the latter test represents the train as it was rushing past the first semaphore at a speed of about forty miles an hour. In Fig. 1 the train is at rest. The construction of the track, the method of laying the conductor rails and the semaphore with its switchbox are well shown.

Armature Disc-Cutting Press.

The requirements of armature work for electric motors and dynamos have led to the construction of presses which differ in essential points from those used for other styles of sheet-metal work.

The usual form of armature is made up of annular discs with notches on the outside or inside circumference. As it is essential to have the outside and inside exactly concentric, it has been found best to adopt dies which, by cutting them simultaneously, eliminate the inaccuracies which are almost unavoidable when the cutting is done in two or more operations. In many cases the notches and key-slots are also punched at the same time, all of which calls for tools having "throwout pads" in addition to the cutting parts, so as to automatically push the discs and scrap out of the dies and punches.

These "throwout pads" are now usually operated by means of heavy springs, which are not always reliable, and consume a great deal of the



ARMATURE DISC CUTTER.

power of the press. The press shown herewith is designed to operate these "throwouts" in a positive manner, and consume but little of the power of the press.

The bottom plate which operates the "die-pads" through radial slots or pin-holes in the bolster, is actuated by an outside crank connection, or by means of two rods connecting it directly with the slide, as shown in the illustration.

Two cross-pieces, adjustably attached to the frame of the press, actuate the "throwout pads" of the punches by striking against them on the return motion of the main slide.

This press is designed by the E. W. Bliss Co., Brooklyn, N. Y. It will cut the outside and inside simultaneously on plain discs up to 31½ feet diameter, and up to 14 or 15 feet diameter, when all the outside notches are to be cut at the same stroke. It may also be used for cutting segments or sections complete at one stroke with all their teeth or holes up to 31½ inches long.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 5, 1897.

ELECTRICAL STOCKS.—There was a general falling off in prices of electrical stocks during the past week. General Electric, which suffered the least decline, lost ¼ on the common issue; the preferred stock receded 2 points. The Westinghouse securities are also on the downward side of the market, and Electric Storage Battery issues lost a fraction.

TELEGRAPH AND TELEPHONES.—General weakness seems to have pervaded this list during the week just closed, all securities having declined. Bell Telephone suffered the greatest loss, closing at a figure 7 points lower than our last quotation. Commercial Cable dropped off 6 points, closing at 150, and Western Union lost 2¾.

ELECTRIC TRACTIONS.—The market for street railway securities was quiet, and some stocks declined on small transactions. Brooklyn City Railroad remained firm in price. Baltimore Traction is the only stock in which an advance is recorded, that being 1½ points, the rest of the list being lower in price.

DIVIDEND.—The New York & New Jersey Telephone Company has declared a quarterly dividend of 1½ per cent., payable April 15.

FINANCIAL OPERATIONS.—The Brooklyn Rapid Transit Company, Brooklyn, N. Y., reports gross earnings for March, $406,671, an increase of $19,977, as compared with the same month in 1896.

MORTGAGE RECORDED.—A mortgage for $20,000,000 was recorded at the Registry of Deeds, Salem, Mass., on March 31, from the Commercial Cable Company, New York City, to the Farmers' Loan & Trust Company, to secure an issue of bonds.

	Par.	Bid.	Asked.
ELECTRICAL STOCKS.			
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	106	..
" " " Brooklyn	100	..	97
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	23	23¼
Electric Storage pref.	100	24½	25
General Electric	100	31¾	32
General Electric pref.	100	72	75
Westinghouse Consolidated, com.	50	22	24
Westinghouse Consolidated, pref.	50	50	51
BONDS.			
Edison Electric Ill., New York, con. 5s	105	110	..
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	96	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	217	219½
American District Telegraph	100	29	39
American Telegraph and Cable	100	88	89
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	175
Erie Telephone	100	63⅝	64½
New England Telephone	100	..	102½
Postal Telegraph-Cable	100	96	98½
Western Union Telegraph	100	80	80⅛
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	20¾	20⅞
Brooklyn Rapid Transit	..	20	21
Brooklyn Traction	100	..	14
Brooklyn Traction, pref.	100	46	48
Buffalo St. Ry	100	72	75
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	41	43
Hestonville	100	48½	50
Hestonville, pref.	..	..	62½
New Orleans Traction	100	..	10
New Orleans Traction, pref.	100	..	25
North Shore Traction	100	19	22
North Shore Traction, pref.	100	77	80
Rochester St. Ry	..	10	15
Steinway Ry	..	45	50
Union Railway (Huckleberry)	..	95	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	72	73
West End, Boston, pref.	100	92	92½
Worcester Traction	100	18	20
Worcester Traction, pref.	100	93	95
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	79½	..
Buffalo St. Ry. 1st con. 5s	100	*106	108
Cleveland Electric Ry. 1st mtge. 5s	100	103	105
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	*102	105
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, April 6, 1897.

ELECTRIC LIGHT ON FERRY BOATS.—The Staten Island Ferry Company proposes to light its ferry boats by electricity instead of gas.

J. H. BUNNELL & CO., 76 Cortlandt Street, are fully satisfied with the way the trade is appreciating their new dry batteries and other recent specialties which they have put upon the market.

THE ZUCKER, LEAVITT & LOEB COMPANY is developing an entirely new line of electro-plating apparatus which possesses great merit and efficiency, and is claimed to be superior to the ordinary apparatus of this kind in general use.

H. D. BAYNE & CO., electrical and mechanical engineers, 39 Cortlandt Street, are getting quite a large number of contracts for electric lighting and power installation work. Mr. H. D. Bayne is at present actively engaged in some very elaborate electrical decorative work.

THE NEW YORK ACCUMULATOR & ELECTRIC COMPANY, 150 Nassau Street, is actively pushing its various storage battery specialties. The storage battery manufactured by this concern is of the Plante type with plates of an entirely new and extremely novel design. Mr. G. W. Harris, the president and treasurer of the company, reports a number of very good orders for electro-medical sets and portable storage battery lamps. The company intends to extensively develop its storage battery for light and power purposes for which the battery is most excellently suited.

NEW YORK VISITORS.—The following named gentlemen registered at the headquarters of the National Electric Light Asociation, 136 Liberty Street, during the week ending April 2: A. E. Carrier, Pittsburg, Pa.; Manuel Brunet and Miguel Garcia, Havana, Cuba; D. D. Dickey, Pittsburg, Pa.; Frederic Nicholls, Toronto, Ont.; A. J. Belden, Syracuse, N. Y.; N. H. Jones, Cleveland, O., and R. T. Robinson, Norfolk, Va. This was President Nicholls' twelfth visit to New York City on association business since his election, and he has traveled over 12,000 miles in the interests of the association.

THE H. W. JOHNS MANUFACTURING COMPANY, 87 Maiden Lane, has recently brought out some very ingenious and excellently designed insulators for overhead electric light and power wires. Mr. W. F. D. Crane, who is in charge of the company's electrical department, informs us that the trade has already appreciated the merits of these new insulating appliances, indicating its entire approval by a number of excellent orders. The company has recently furnished the complete insulating material for several large roads in New England and elsewhere and feels well satisfied with present business aspects.

THE SPENCER ELECTRICAL COMPANY, 163 Greenwich Street, manufactures an excellent telephone set which is adapted for both interior intercommunicating and long distance telephone service. The interior set is particularly interesting, as no local batteries are used, one centrally located battery supplying all the various stations. The Spencer Company some eight or nine months ago built a successful submarine telephone equipment which is in use at Pensacola, Fla. This set consisted of a diver's helmet equipped with a transmitter, receiver and call key, the latter being operated by a movement of the chin on the part of the diver, the wires from the diver's apparatus passing through the air tube and connecting with the operator's instruments on the float. Mr. J. H. Spencer, the president of the company, reports an excellent outlook for business. The company is proud of the transmitter used with the telephone sets, which possess features of great superiority.

MR. HERBERT A. MAY, secretary and manager of the Electric Engineering & Supply Company, Syracuse, N. Y., was in New York during this week on a visit to Mr. F. M. Hawkins, the resident New York agent of the company. Mr. May reports a continued improvement in business, with a promising outlook for the future.

THE CONDUIT WIRING COMPANY, 12 West 29th Street, New York City, has discontinued business and the officers have applied to the Supreme Court for the voluntary dissolution of the corporation. The company has no debts and no assets, and its contracts have all been transferred to the firm of Davis & Brussell.

H. W. JOHNS MANUFACTURING COMPANY twenty-five years ago established its offices at 87 Maiden Lane, New York City, and its business has increased to such an extent that a removal of headquarters is rendered absolutely necessary. The company has leased and is now fitting up for salesrooms, accounting department and private offices, the ground floor of the new Woodbridge Building, at the corner of William, John and Platt Streets. The basement will be utilized for stock rooms. The new offices will be among the finest in the city and with the increased facilities the company expects to be able to render more perfect service to its customers than in the past.

NIAGARA FALLS NOTES.

NIAGARA FALLS, N. Y., April 2, 1897.

THE NIAGARA FALLS & LEWISTON ELECTRIC ROAD, "The Gorge Route," has ordered ten new cars of the J. G. Brill Company, Philadelphia. This will give the road an equipment of thirty trolley cars. The new cars will be equipped with a new patented automatic electric brake.

MR. L. B. STILLWELL, the former chief electrical engineer of the Westinghouse Electric & Manufacturing Company, Pittsburg, but now the electrical director of the Cataract Construction Company and the Niagara Falls Power Company, has taken up his residence with his family at the Falls.

THE CHEMICAL CONSTRUCTION COMPANY.—It is reported that the Chemical Construction Company, whose plant has been closed all Winter owing, it is said, to the failure to make the process a perfect success, is about to start up the works. This company has an electrical process for making chloride of potash.

EXTENSION OF WHEELPIT.—The work on the extension of the wheelpit for the Cataract Construction Company is progressing fairly well. The work has now reached a depth of 125 feet. The pit will go down to 180 feet. It is expected that this work will be completed in three months' time, when everything will be in readiness for the turbine wheels, penstocks and shafts. The installation of the generators will be made late in the Fall.

THE CARBORUNDUM COMPANY'S CANADIAN PLANT.—It is said that the Carborundum Company is negotiating with the Niagara Falls (Ont.) Electric Light & Power Company for 100 horse-power for its new plant, which the company is forced to establish on the Canadian side of the river to protect its Canadian patents. It was hoped that the Ontario Government would have settled the power question before this and given the electric road on the Canadian side, whose power-house is in the park, the right to sell its surplus power.

THE MATTHIESON ALKALI COMPANY will immediately construct its new bleaching chambers adjoining its transformer building. This latter is nearly completed and is a building 298x212 feet. The bleaching chambers will be 210x100 feet, and in them will be stationed the apparatus for the bleaching process. The electrical work for this firm was done by the Westinghouse Electric & Manufacturing Company. The equipment consists of eleven 200-hp transformers of the static 22 type. There will be several smaller motors which will be used for power about the plant and for lighting. The Alkali Company has a contract for 2,000 horse-power with the Niagara Falls Power Company.

PITTSBURG NOTES.

PITTSBURG, PA., April 5, 1897.

THE ORDINANCE granting rights of way to the Pittsburg & Mount Washington Street Railway Company, which has been previously referred to in THE ELECTRICAL WORLD, passed both Select and Common Councils on March 29.

MR. A. C. V. SCHOTT, formerly of 830 Liberty Street, has moved his works to 918-920 Penn Avenue, Pittsburg, Pa. Mr. Schott manufactures switches, switch and tablet-boards, and is busily engaged in general electrical repair work.

THE HOME TELEPHONE COMPANY last week encountered the first serious obstacle in its struggle for franchise. After a prosperous passage through the committees and through Select Council, its Allegheny ordinance was defeated in Common Council, where only 18 votes could be mustered in its favor, when 21 votes were necessary for its passage. This was the last meeting of the present Council, but the measure will undoubtedly be introduced again after the organization of the new councils. It is thought that it would have passed easily at the last meeting had the attendance been larger.

THE CARNEGIE STEEL COMPANY is keeping abreast of the times in electrical matters. In its mills at Duquesne and at Homestead are to be found two extensive and well-equipped plants for electric lighting and power, each built on modern lines. At the Homestead mill was made the first application of electric motors for driving roll tables, and there is also an extensive equipment of electric traveling cranes in the beam yard, by means of which the handling and shipping of the heaviest beams are accomplished with the greatest rapidity and economy. The Edgar-Thompson Steel Works at Bessemer are now falling into line by the construction of an entirely new and modern power house, under the supervision of their electrical superintendent, Mr. A. E. Maccoun. This mill was one of the first to adopt electric lighting and its order for two 40 light Brush arc machines in 1880 was probably the largest single order for arc apparatus that had been placed up to that time. The present lighting outfit consists of four 65-light Brush arc machines, and one T. H. 50-light machine, and two Westinghouse quarter-phase alternators. The requirements for power distribution have increased rapidly of late years and have been met by the erection of two power houses in addition to the original lighting plant. It is now proposed to consolidate all the lighting and power machinery in a single building, which will be located near the river bank and adjacent to the blast furnaces. The present arc machines will be replaced with four of the new type 125-light Brush dynamos equipped with the "multi-circuit" attachment to obviate excessive voltages. Four Buckeye engines of 500 horse-power each will be used for driving the various lighting and power generators, and all the arrangements and details will be designed with the view of obtaining high economy and convenience in operation, and so that risk of interruption to any part of the service will be as remote as possible. The transmission lines will also be remodeled, being carried upon steel poles for out of door work and the installation throughout will be placed upon a modern footing.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, ILL., April 5, 1897.

CHICAGO ELECTRICAL ASSOCIATION.—The next meeting of this association will be held on April 16, at which Mr. C. Wiler will read a paper entitled "Arc Lighting in Europe and America."

THE SAWYER ELECTRICAL COMPANY, Lippincott Building, Philadelphia, Pa., has taken the agency for Eastern Pennsylvania of the Royal alternator, manufactured by the Royal Electric Company, Peoria, Ill.

STRIKE OF ELECTRICAL WORKERS.—On April 1 one hundred and fifty electrical workers, members of the Brotherhood of Electrical Mechanics, struck for the restoration of the old scale of wages—$3 for eight hours' work. The members of the Master Wireman's Association refused to grant the request. Work on eight buildings was suspended on account of the strike.

THE ELECTROTECHNIC CLUB, Minneapolis, Minn., held a banquet at the Guaranty Loan Building, on the evening of April 1. Prof. George D. Shepardson presided, and several interesting addresses were made. It was announced that the meeting would be the last one of the society under its old name. The society is to be reorganized under the name of the Twin City Electrical Engineers' Club. A Committee of Organization was appointed and Mr. A. W. Zahm, of Minneapolis, was instructed to induce St. Paul electrical engineers to join the new club with a view to holding alternate meetings in the two cities. Among the speeches made were the following: "Electric Clubs," by Charles L. Pillsbury; "Electricity in Europe," by Oliver T. Erickson, and "Municipal Ownership of Electric Lighting Plants," by A. W. Zahm. Mr. Morgan Brooks of Minneapolis talked on the "Telephone," and other remarks were made by different ones present.

MILWAUKEE NOTES.

MILWAUKEE, WIS., April 5, 1897.

THE BEET SUGAR CO., Menomonie Falls, has let the contract for an electric light plant to Keelyn & Smith. Two hundred and fifty incandescent lights, 21 Manhattan arc lamps and a 500-light dynamo and engine will be installed.

BIDS TO BE ASKED FOR.—The Blatz Brewing Company is remodeling the old Wellington Hotel. A complete and modern electric light and power plant will be installed. As bids have not yet been asked for, nothing definite is known.

MARINE ELECTRIC PLANTS.—The Flint & Pere Marquette Transportation Company is having its steamer No. 5 equipped with an electric light plant. There will be about 150 lights all told, current being furnished by a 10-kw General Electric direct-connected unit. This plant is being installed by the Julius Andrae & Sons Company, who recently put in plants on steamers No. 3 and No. 4 for the same company.

ELECTRIC LIGHTS AT A SUMMER RESORT.—Lake La Belle summer resort will be ablaze this summer with electric lights. A $3800 contract has just been closed with Keelyn & Smith. The place will be wired for 700 incandescent lights and 9 Manhattan arc lamps. Current will be furnished by a 600-light dynamo run by a 50-hp engine, belt connected.

A PIONEER ELECTRIC PLANT.—An interesting and novel plant will soon be installed in the residence of Wm. Becker. The house has been wired for some time for 250 lights but as the lighting company's mains were at a great distance, he decided to put in a private plant. A 12½-kw Gibbs dynamo will be run by a 20-hp Dayton gas engine. The most interesting feature will be the installation of 58 cells of 50 ampere-hour chloride accumulators. This will be the first plant of its kind installed in this city. Goltz & Sinclair are the contractors.

TO REBUILD ITS ROAD.—The Milwaukee Electric Light & Railroad Company will go to a considerable expense in rebuilding its tracks on Howell Avenue. The tracks have been in poor condition for some time and have been the means of derailing cars several times, luckily without much damage.

IMROVING TRADE CONDITIONS.—The majority of the contractors in this vicinity report that they are gradually recovering from the effect of the dull times. They claim to have good prospects in view which, if realized, will do much to improve the present conditions. It is understood that several large deals are under consideration but nothing definite is known as to their exact nature. Figuring in architect's offices has been very brisk of late. That the business public is still trying to keep expenses down is shown by the great demand which has been made for second-hand dynamo and motor machinery.

St. Louis Notes.

St. Louis, Mo., April 5, 1897.

NEW TELEPHONE SYSTEM.—W. J. Kurtz, of the National Construction & Telephone Company, is in the city to organize a company to manufacture telephones and to start a telephone system. If he succeeds, he will rent telephones for $36 a year.

THE KINLOCH TELEPHONE COMPANY is pushing its conduit work, which it hopes to have completed by July 1, next. It now has 4000 subscribers, and by July 1 that number will be greatly increased. It has also secured a franchise for a telephone system in East St. Louis, and has secured the right to run its wires across the Eads Bridge.

THE PEOPLE'S ROAD.—Mr. Thomas C. Barr, of East Orange, N. J., and Mr. F. J. Moon, of Philadelphia, are now in St. Louis in consultation with Receiver Green, of the People's line, and the visitors are ready, it is said, to buy the road. If they succeed, it will be extended south to Jefferson Barracks and north to the Fair Grounds. The minority stockholders oppose the plan of reorganization proposed by the receiver and will fight it.

THE SOUTHERN ELECTRIC RAILWAY.—Three-fourths of the stock of the above road passed into the hands of local capitalists last Thursday. Papers were signed by the local purchasers and checks aggregating nearly $700,000 were turned over to the Louisville stockholders. Charles F. Orthwein was elected president, to succeed Claude Kilpatrick; Corwin H. Spencer was elected vice-president, and Joseph Minary was re-elected secretary and treasurer. The road will be improved and operated as an independent line. There will be no consolidation with any other line. The road was purchased as an investment.

EDISON ILLUMINATING COMPANY REORGANIZATION.—The Edison Illuminating Company is now in a position to be reorganized according to the plan set on foot several weeks ago. The organization committee have gone over the books and found that nearly all the outstanding bonds have been sent in by the holders. In return for these bonds the holders receive trustees' certificates, which will be exchanged for bonds of the new company after the reorganization is effected. In accordance with the plan proposed, the bonded indebtedness of the company will be reduced from $4,000,000 to $2,000,000 and the capital stock will be reduced from $8,000,000 to $4,000,000. The committee will make application in court some time this week for the order of sale. The committee will buy in the property for the bona-fide holders and the company will then be reorganized.

Pacific Coast Notes.

San Francisco, Cal., March 27, 1897.

MR. J. T. GAFFEY, of Los Angeles, Cal., has been granted a franchise for his projected San Pedro street railway line.

MR. C. S. KNIGHT, vice-president of the Fort Wayne Electric Corporation, Fort Wayne, Ind., is in the city on business connected with his company.

MR. J. W. GODFREY, of New York, who is manager of the sales department of the India Rubber & Guttapercha Insulating Company, New York City, recently arrived in this city, where he will arrange for a local representative.

MUNICIPAL PLANT.—The city of Spokane, Wash., will decide by a popular vote the question of a loan of $80,000 to be expended in the installation of a municipal electric lighting plant. Water power is abundant in that city.

TELEPHONE LINE.—Advices from San Rafael, Cal., state that a telephone line will soon be constructed from Mill Valley to the "Tavern of Tamalpais," on the mountain side. The hotel may be lighted with electricity, as a proposition is being considered.

THE MARKET STREET RAILWAY COMPANY, San Francisco, has just announced dividend No. 6, of 60 cents a share on the issued stock of the company. The company has been making a trial of bicycle holders on some of its cars with good results. Each of the Hayes street cars has been equipped with holders for two bicycles. They will be put into use at once, the fare being 5 cents per "bike." Transfers will not be given to other lines for bicycles.

MR. PHILIP HINKLE, a pioneer elevator manufacturer, of San Francisco, recently disposed of patent 257,943, which he took out May 16, 1882, for an over-counterbalance worm-gear machine. He met with reverses, which drove him out of the business, and his patent was almost forgotten. A short time ago some parties in this city, learning of the existence of the letters patent, bought them from Hinkle. The Overweight Counterbalance Elevator Company, of San Francisco, has since been incorporated with John L. Boone, H. L. Webber, C. M. Weyman, Charles J. Armbruster and C. Bennett as stockholders. Mr. Boone recently said: "We will not manufacture elevators at present, but we intend to lay a royalty on every elevator that infringes on our rights under this patent. We will lay a royalty of half the amount our contrivance saves the owners of the elevators. This will not only include the future, but we will collect royalty for two years back." It is understood that the new company will not disturb the users of hydraulic elevators. Nor will it aim to interfere with manufacturers, but will collect royalty from users, if possible. Local manufacturers are not much afraid of the company's claims. Some say that the patent will cover only machines using a drum and worm, as shown in the patent drawings, and that it will affect only those having a cable depending from both sides of the drum. Elevators not over-counter balancing will not be affected, evidently. Mr. Boone is a pioneer patent attorney.

New York State Notes.

RAILWAY EXTENSIONS.—The Catskill Electric Railway Company has filed a certificate with the Secretary of State, announcing several extensions of the road, in the villages of Cairo, Catskill, and to Jefferson Heights.

THE STATE RAILROAD COMMISSION has granted the New Paltz & Walkill Electric road the right to construct a trolley line from Highland to New Paltz, on condition that it should not cross the Walkill Valley road or the West Shore at grade.

TELEPHONES IN THE ADIRONDACKS.—A new telephone line will be constructed from Old Forge in the Adirondacks to Fourth Lake, and later on the line will be extended to Racquet Lake, across which a cable will be laid and the line continued to Blue Mountain Lake.

TELEPHONE FRANCHISE GRANTED.—The Oswego City Council has granted a franchise to citizens to establish a telephone exchange. The franchise stipulates that the city is to have seven free instruments, and the company must file a bond for the faithful execution of its purpose.

THE CENTRAL NEW YORK TELEPHONE COMPANY will commence the work of constructing a long-distance line from Watertown to Alexandria Bay, thus giving an outlet to the Thousand Islands region. Another long-distance line will be run from Watertown to Ogdensburg, Gouveneur, Canton and Potsdam.

RAILWAY SHUT DOWN ALL WINTER.—The Oswego Electric Railway has been shut down all winter, owing to lack of power. The water was drawn off the hydraulic canal, which is fed by the Oswego Canal, and the power station had no water. A New York syndicate is negotiating for the purchase of the stock and bonds of the company, and will put the road on a good operating basis.

NEW TROLLEY LINES.—An effort is being made to connect Hoosick Falls and Bennington by trolley line. There is a trolley service between Hoosick Falls and Walloomsac, and the distance from there on is eleven mile. The proposed line will also pass through North Bennington. The power for the line is to be furnished by the Hoosick Falls Water Power & Light Company, which is now increasing its capacity in anticipation of the extension. A new 350-hp generator has been ordered from the General Electric Company. Negotiations are pending for another set of turbine wheels, adding 300 horse-power. The steam plant will also be increased to the capacity of 300 horse-power. Another new electric line is projected from Lyons to Sodie's Point, N. Y. The road is to be built for passenger and freight traffic. It is claimed that leading stockholders of the Fall Brook Railway are interested in the construction of this line.

Canadian Notes.

Toronto, Ont., April 5, 1897.

FIGHT OVER TELEPHONE RATES.—Toronto is having a big fight with the Bell Telephone Company over the latter's effort to raise rates in this city. The matter has been carried to the Dominion Parliament in Ottawa and considerable lobbying is going on to keep the company down to its contract rates made with the city.

NEW ELECTRIC RAILWAYS.—The Railway Committee, of the Provincial Parliament, has reported favorably on the bills to incorporate the Lanark County Electric Railway Company to run a trolley line from Perth to the village of Lanark; for the South Essex Electric Railway Company to construct a line from Amherstburg to Leamington, and from Amherstburg to Windsor; for the Fort Erie Electric Railway Company to extend its line from Fort Erie to Chippawa to connect with the Niagara Falls Park & River Company; to incorporate the Ingersoll Radial Railroad Company and the Fort Thomas & Pacific Railway Company.

SUNDAY STREET CARS.—A bill is before the Provincial Parliament to amend the Electric Railway Act of 1895. The bill brings incorporated villages within the meaning of the Electric Railway Act; that is, as the act now stands, electric railway companies can not be incorporated in villages. The Electric Railway Act of 1895 prohibits the running of street cars on Sunday, but the courts now hold that companies incorporated before this amendment was added to the act do not come within its provisions. Nearly every company incorporated since has asked the Railway Committee of the Parliament to exempt them from the provisions of this act. The committee has invariably refused.

Ottawa, Ont., April 5, 1897.

NEW CAR-FENDER.—The Ottawa Electric Railway has given a trial to a new and somewhat novel car-fender. The fender covers the front part of the car to a few inches below the number. It is covered by a part of the car to a few inches below the platform. It is covered by a wire netting, and protrudes about five feet from the car. The affair

works upon a lever, and upon the slightest touch it is thrown down and makes a place of entire safety for the person who may happen in the road of the car. The vibration of the car does not affect it, and it does not move from its upright position.

MAIL CONTRACT.—The Montreal Belt Line, the electric railway which runs from Montreal to Longue Pointe and other places, has secured the mail contract between those places. The new arrangement calls for a service twice a day each way. The company has received a pair of eight-wheeled coaches set upon double trucks and capable of running thirty-five miles an hour. Fifty minutes has ordinarily been consumed in making the run to the end of the island, but this time will now be cut to twenty-five minutes with the new rolling stock. On May 1 a twenty-minute service will be established early in the day, which will be increased to a car every ten minutes.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, March 24, 1897.

THE NATIONAL TELEPHONE COMPANY.—The fourth annual dinner of the staff of the National Telephone Company, which recently took place, was the occasion of an inspiring display of mutual admiration on the part of telephone and postal telegraph officials. Mr. Preece, who was of course among the after dinner speakers, stated that although the telephone trunk system in England had been in the hands of the Post Office for only a year, more trunk lines were at the present moment in operation in England than were to be found in the whole of Europe, and Mr. Dane Sinclair, the chief engineer of the company, also laid great stress upon the development of duplex telephony in this country, of which he claimed there was more in England than anywhere else.

THE LIVERPOOL MUNICIPALITY AND ELECTRIC TRACTION.—Quite recently the Liverpool Corporation acquired the undertaking of the local tramway company for the sum of £400,000, and now, as the result of negotiations between the Special Committee of the Liverpool Corporation and the representatives of the Liverpool Tramways Company, a provisional agreement has been entered into under which the company's undertaking will be acquired by the Corporation as from January 1 last for £560,000. This arrangement gives the shareholders a considerable premium, the holder of every £10 share receiving £12 15s., and in accepting this arrangement the representatives of the Liverpool Corporation had regard to the fact that the annual earnings of the company approximated £35,000, and that the company had an unexpired lease of eighteen years. They also had in view the fact that the introduction of electricity, which they contemplate, might reasonably be expected to reduce the cost of working by 50 per cent., whilst it would largely increase the number of passengers carried.

ELECTRICAL OMNIBUSES.—The London Electrical Omnibus Company which started its public existence with such a tremendous flourish of trumpets a few months ago, and which led the unwary to believe that within a few weeks regular services of electrical omnibuses would be started in various parts of London, has not so far started a single omnibus, much less a single complete service, and the company has, since its application for capital, confessed that the system adopted by it has been completely revolutionized, so that it is somewhat difficult to see what it is the public paid for last Autumn. The company at the time of its formation laid emphatic stress upon its so-called patent methods of working. Significant of its non-success is the fact that the company is now raising further capital by issuing new £1 shares, instead of calling up the balance due upon the shares already issued. The curious explanation of this curious proceeding given by the chairman is that he thought shareholders would prefer to increase their holdings in the company at the present low prices, rather than to complete the purchase of the shares they had previously taken. It did not seem to occur to him that many of those who had been sufficiently guileless to take shares would rather forfeit them than pay up the balance due upon them.

THE CHEAP LAMP QUESTION.—The necessity under which our central station engineers lie of competing with gas has resulted in the evolution of a large number of curious methods of charging for current supplied, and the necessity under which they also lie of preventing the propagation of cheap and poor lamps has also resulted in the exercise of considerable ingenuity. At present there are some three methods of protecting the consumer from the insidious advances of the vendor of worthless lamps. For some two years past the Kensington & Knightsbridge Company in London, with which Mr. R. E. B. Crompton is so closely connected, has taken the supply of lamps to its customers entirely into its own hands, carefully testing each lamp before it is sold. At Bradford and in a few other towns, the electric lighting undertakers are trying to kill two birds with one stone, that is to say, they are supplying a certain number of carefully tested lamps every quarter free to their customers, the number being based upon the units consumed by each consumer during the last quarter. In this way the consumer is supplied with good lamps instead of poor, and his electricity bill is reduced in a twofold manner, since the lamps do not consume as much current for the same amount of light and he has nothing to pay for them. A third system is now being tried at Dover by the local lighting company. The company is a small and struggling one, and has only recently started operations, and is not therefore in a position to be generous, but it has sent a circular around to all its customers suggesting that in their own interests they would be well advised in sending all the lamps they buy to the company's engineer to be tested, the charge for this service being 1d. per lamp. There are, I believe, at present in vogue something like a dozen different methods of charging for current. It will be interesting to see whether there will be such a variety in the methods of defeating the pernicious consequences arising from the influx of cheap lamps into this country.

General News.

NEW INCORPORATIONS.

THE TEXAS SOUTHERN RAILROAD COMPANY has been incorporated with a capital stock of $300,000. Those interested are E. Key, E. J. Fry and Y. D. Harrison.

THE GLENDALE POWER COMPANY, Glendale, Mass., has been incorporated with a capital stock of $50,000, to generate electricity from water power in that place.

THE WASHINGTON, WESTMINSTER & GETTYSBURG RAILWAY COMPANY has filed articles of incorporation. The incorporators are William B. Thomas, James A. C. Bond, Charles T. Reifsneider and T. Herbert Shriver. The office of the company is at Union Bridge, Md. Capital stock, $100,000.

THE WESTERN ELECTRIC TELEPHONE COMPANY has been incorporated at Sioux Falls, S. D., with a capital stock of $500,000. The incorporators are T. A. Potts and Francis A. Way, of Britt, Iowa; Stitzel T. Way, Wesley, Iowa; Fred Dunn, Canton, S. D., and Charles E. Hill, of Valley Springs, S. D.

THE RED RIVER, TAOS & SANTA FE TELEPHONE COMPANY, Santa Fe, N. M., has been incorporated with a capital stock of $50,000. The promoters are Delos Durfee, of Colorado Springs; John H. Denny, William R. Rynerson and Henry C. Brailey, of Red River, and Frank Staplin, of La Belle, N. M.

THE COMMERCIAL TELEPHONE EQUIPMENT COMPANY, Rensselaer, Ind., has filed articles of incorporation with the Secretary of State, with a capital stock of $25,000. Those interested are Delos Thompson, of Rensselaer; Edward H. Andress, of Lafayette; Charles E. Mills, of Rensselaer, Thomas J. McCoy and James F. Watson, both of Rensselaer.

TELEGRAPH AND TELEPHONE.

CARTHAGE, IOWA.—The Western Illinois Telephone Company has been granted a franchise by the City Council to build an exchange in this city.

LOWELL, MASS.—The Erie Telegraph & Telephone Company made a net gain of 198 subscribers in February. Total number connected March 1, 21,752.

WATERTOWN, S. D.—Negotiations are pending with the Standard Telephone Company to construct a line from this city to Redfield, where it will connect with the Redfield-Aberdeen line.

BRITT, IOWA.—It is stated that the Western Electric Telephone Company will build 1000 miles of new line this year. The promoters, it is stated, are well satisfied with the financial results of the enterprise.

THE HARRISON INTERNATIONAL TELEPHONE COMPANY.—A dispatch from Chicago states that Judge Crosscup, on April 5, declined to appoint a receiver for the Harrison International Telephone Company on the bill of several stockholders.

DES MOINES, IOWA.—A number of stockholders in the Mutual Telephone Company have about completed the organization of a stock company to build and maintain toll lines out of Des Moines, but operated in conjunction with the Mutual exchange. The lines will be built in several directions from the city, connecting with independent lines already in operation and with towns with which Des Moines has no present connection.

PRINCETON, KY.—The East Tennessee Telephone Company has opened its new exchange in this place and it is working nicely. The company had 55 subscribers to start with, and is adding new ones daily. The system is well liked by the subscribers. The company is installing an exchange at Franklin, Ky., and expects to have it in operation before the latter part of May. There will be extensions in toll lines from Princeton to Hopkinsville and Paducah during the coming Summer, which will give this city the benefit of long distance service.

ELECTRIC LIGHT AND POWER.

LITTLE ROCK, ARK.—A new electric light plant will be put in by the Little Rock Traction Company.

M'MINNVILLE, TENN.—The citizens voted to issue $30,000 in bonds to establish a waterworks and an electric plant.

DEFIANCE, OHIO.—The city authorities are investigating the cost of establishing a municipal light and water plant.

NEW LONDON, OHIO.—The corporation voted to bond the town for $8000 for the purpose of establishing an electric light plant.

CORUNNA, MICH.—The citizens will vote at the April election on the question of issuing bonds to establish a municipal lighting plant.

WAVERLY, OHIO.—According to the Electric Light Committee's report for the year ending Jan. 31, 1897, the expenditures exceeded the receipts by $1538. "It would appear from the above figures," says a local paper "that the Waverly electric light plant is not a very paying investment."

PAULDING, OHIO.—Sealed proposals will be received by the clerk of the village of Paulding until 10 a.m., April 28 next, for lighting the streets of this place with arc electric lights for a period of five or ten years, in accordance with the plans and specifications on file at the clerk's office. Mr. H. G. Remage is the clerk.

MIDVALE, PA.—The Midvale Steel Company is about to build an electric power and light station at Hunting Park Avenue and Reading Railroad.

LEHIGHTON, PA.—A special election was held here on March 30 on the question of municipal ownership of an electric light plant. A vote was cast in favor of the proposition by a large majority.

IRVINGTON, IND.—The Town Board of Irvington, Ind., on April 29 next, will take up the question of lighting the town by electricity. Propositions and specifications are invited, particularly with a view to the construction of a plant which at the end of ten years shall become the property of the town. Such a plant must offer facilities for arc and incandescent lights and for power. Other plans, however, may be submitted.

FORT WAYNE, IND.—Sealed proposals and bids will be received by the Board of Commissioners of the County of Allen, Fort Wayne, Ind., until 2 p. m., May 15, next, for furnishing all the material and doing all the work requisite for the building of the new courthouse and for the power station. Copies of the drawings and specifications can be obtained at the office of Mr. B. S. Tolan, the architect, Fort Wayne, Ind., and Pierce & Richardson, Chicago, Ill., who are the consulting electrical and mechanical engineers for the architect. Copies can also be obtained of the *Engineering News*, New York City.

ALBANY, N. Y.—A bill was introduced in the Senate last week to incorporate the Columbia County Electric Company, whose object is to build three dams along Kinderhook Creek in Columbia County, N. Y. The water power thus obtained will be utilized in generating electric power. The storage capacity thus developed will be very large, and it is estimated that the sum of five million dollars will be expended by those interested in the scheme to develop the project. Incidentally the company will furnish pure water to villages in Rensselaer and Columbia Counties. Its principal object, however, will be to furnish power to parties requiring the same.

ATLANTA, GA.—It is stated that a large water power electric plant is to be established at High Falls on the Towliga River in this State. There is a fall of 105 feet producing, at a low estimate, fully 2000 horsepower. Messrs. Boyd & Grantland, of Griffin, Ga., are at the head of an enterprise to develop this water power. A dam will be thrown across the river and it is proposed to generate a direct current up to 11,000 volts and transmit the same to Griffin, fifteen miles away, where it will be used for lighting and power purposes.

LONG BRANCH, N. J.—The Consolidated Gas Company of this place is enlarging its electrical plant in order to meet the increasing demand for current. The work is being carried on under the supervision of Mr. Alexander Anderson, the company's electrical superintendent. A new 300-hp cross-compound condensing engine and a 3000-light General Electric incandescent dynamo are being installed in the new plant. The new equipment will increase the capacity of the station to 6000 incandescent lights and 200 arc lights. Two boilers of 150 horse-power will be added to the present boiler plant. The J. D. Miller Engineering Company, New York City, is the contractor for the engines and connections, and the boilers are furnished by Samuel Smith & Co., Paterson, N. J.

The Electric Railway.

LYONS, N. Y.—There is a strong effort being made to construct an electric railroad from this village to Sodus Point.

PORTLAND, ME.—It is stated that a plan for an electric railway between Portland and Boston is proposed by Boston and New York capitalists.

DOYLESTOWN, PA.—Operations on a new trolley line to be built from the Eastern line of the Borough of South Bethlehem to Hellertown will begin in the near future.

PORT CHESTER, N. Y.—The Port Chester Street Railway Company has made application for a franchise for a line through the streets of the village of Rye to Rye Beach.

BALTIMORE, MD.—A waterworks and an electric light plant will be built at Tacoma Park, Maryland. A survey is now being made and if satisfactory the committee in charge of the work of preparing plans will commence at once.

TORRINGTON, CONN.—The capital for the Torrington-Winsted trolley road has been subscribed. Torrington and Winsted capitalists are each to hold $26,000 worth of stock in the road and $150,000 will be subscribed by outside parties.

CHICAGO, ILL.—It is stated that the Board of Directors of the Illinois Central Railroad Company has formally approved the proposition to substitute electric power for steam in the operation of its local suburban trains and authorized the president to take the necessary steps to carry out the order.

DOYLESTOWN, PA.—It is stated that the Pennsylvania Railroad Company is considering plans to equip its local lines with electricity on the trolley system. The purpose of the company, it is stated, is to give continuous service to suburban points, especially to those places where trolley lines now exist.

TAMAQUA, PA.—President Riley of the Lehigh Coal & Navigation Company is authority for the statement that in a few days the Tamaqua & Lansford Street Railway Company will begin the construction of the electric railway which will connect Tamaqua with Mauch Chunk by way of the Switchback.

DOYLESTOWN, PA.—About 200 citizens of Perkasie and the immediate vicinity held a meeting in that place to discuss the feasibility of organizing a company for the purpose of constructing a trolley railway between Perkasie, Sellersville and Benjamin and also lighting these towns with electricity.

ST. LOUIS, MO.—The Board of Directors of the Terminal Railroad Association has under consideration a proposition to change the motive power of the terminal system from steam to electricity. The idea of the Terminal Association is to dispense with its steam locomotives altogether and pull by electricity all trains that enter the city.

LIVERMORE FALLS, ME.—It is proposed to build a new electric road between here and Jay Bridge, and a company has been formed for the purpose, under the title of the Electric Railroad, Waterworks & Power Plant Company. The distance between the two places is two and one-half miles and the road, it is estimated, will cost $30,000. It will be built by private capital.

MERIDEN, CONN.—Work on the electric road between Berlin, New Britain and Hartford, which is being carried on by the New York, New Haven & Hartford Railroad Company, is being advanced energetically. The power house at Berlin is nearing completion and the engines and boilers will be put in place at once. Work on the laying of the third rail is well advanced, and it is expected that the line between Hartford and New Britain will be in operation early in the Summer.

DOYLESTOWN, PA.—Judge Yerkes on April 1 granted a permanent injunction restraining the Philadephia & Bristol Electric Railway Company from occupying the Bristol turnpike in Bristol Township with its trolley lines. The Pennsylvania Railroad Company objected to the trolley line at this point and its success in obtaining this injunction apparently prevents the new road's further extension. It is stated that the Philadelphia & Bristol Electric Railway Company has expended several hundred thousand dollars in the building of several miles of track and a power house, besides the construction of a bridge in Bucks County. It expected to continue its line to Trenton and ultimately to New York.

NEW YORK CITY, N. Y.—It is reported that an alliance of the Brooklyn trolley companies and the Consolidated Traction Company of Jersey City, is contemplated, for the purpose of running through cars from Newark and the Oranges, in New Jersey, to Brooklyn and the remote towns on Long Island. The Brooklyn Heights Railroad Company and the Brooklyn Annex Company are interested in the movement. It is proposed to carry the cars between Jersey City and Brooklyn by the Annex ferries. A definite plan, it is stated, has been arranged and the agreement perfected. It is reported that the union will be consummated and that through cars will be in operation before the Summer season opens.

Personal Notes.

MR. J. W. MARSH, vice-president and manager of the Standard Underground Cable Company, Pittsburg, Pa., was in New York during the week.

MR. THOS. E. HUGHES, who will have charge of the insulated wire department of the Standard Underground Cable Company in the metropolis, is being introduced to the trade by Mr. George L. Wiley, manager of the company's New York office.

Obituary Notes.

MR. BERNHARD EEKHOUT, a member of the firm of H. D. Bayne & Co., electrical engineers, 39 Cortlandt Street, New York City, died at Colorado Springs, Col., on April 2, of hemorrhage of the lungs. Deceased was born in Glasgow, Scotland, 29 years ago, receiving his education in Edinburgh. He came to this country eight years ago and settled in Baltimore. Two years ago he entered electrical engineering in New York. His remains will be buried at New Dorp, Staten Island.

MR. CARLTON M. WILLIAMS, treasurer of Morse, Williams & Co., the well-known elevator builders, Philadelphia, Pa., died at San Diego, Cal., on March 8 last, of lung trouble, with which he had been battling for several years. He was a man of large business ability and of a high Christian character and was esteemed by all who knew him. His death will have no effect on the affairs of his company, as he had retired from active business.

Trade and Industrial Notes.

THE ROLLINS ENGINE COMPANY, Nashua, N. H., has just issued a catalogue describing the new Rollins automatic cut-off engine, manufactured by this company. This type of engine is doing some very excellent work in Eastern States, and merits the attention of managers of electric light and power stations.

REFLECTORS.—The full line of aluminum reflectors which the Central Electric Company, Chicago, is carrying in stock is meeting with a ready sale, they being considerably lighter than the old style reflectors, with the same radiating effect, and possessing certain points of superiority which the trade will find worthy of their investigation.

THE BALL & WOOD COMPANY, 120 Liberty Street, New York, is furnishing one of its 150-hp standard simple engines to the large works of Messrs. David S. Brown & Co., New York. Last week it shipped a standard simple engine of 175 horse-power direct coupled to a Siemens & Halske generator to the D. L. & W. Railroad shops at Buffalo, N. Y. The company has orders on its books which will keep it busy probably until about the first of July, running full time.

THE STERLING MANUFACTURING COMPANY, 93-103 Bank Street, New York City, informs us that it has secured more commodious quarters in the Lexington Building, 141-155 East Twenty-fifth Street, where it will be better able to transact its increasing business. This company manufactures a general line of street railway supplies, and President J. H. Carson will be pleased to have the company's friends inspect the new plant.

MESSRS. OSTERBERG & SUTTON, consulting engineers and electrical experts, 27 Thames Street, New York City, are preparing plans and specifications for a radical change in the Bay Shore, L. I., electric light plant. The present direct-current plant in that place is to be changed to alternating current.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, 2017-2023 Locust Street, St. Louis, Mo., always keeps in stock a large assortment of Wagner transformers and switches, thus enabling it to make prompt shipment of orders. The Wagner apparatus is sold wholly on its merits and gives very general and permanent satisfaction.

THE CINCINNATI SCREW & TAP COMPANY, Cincinnati, Ohio, has issued a folder describing, illustrating and giving prices of its screws, bolts, nuts, taps, dies, drills, etc. The Starrett high-speed indicator handled by this company is an efficient device for recording the speed of machines. This company manufactures a first-class line of goods.

THE STANDARD BOILER COMPANY, 1120-1121 Marquette Building, Chicago, has just issued a descriptive catalogue of the Standard water tube boiler. The catalogue is very handsomely illustrated with half-tone cuts showing various plants where these boilers have been installed, and reports of tests are given which show excellent results from these boilers.

I. P. FRINK, 551 Pearl Street, New York, has just completed a very elaborate installation of reflector lights in the new art galleries of the Brooklyn Institute of Arts and Sciences. This building is to be opened to the public for the first time on Easter Monday, April 19. The lighting of the galleries has been made a special feature of the installation, which is very complete in all its details.

THE DAVIS & EGAN MACHINE TOOL COMPANY, Cincinnati, O., has just received an order from Messrs. DeFries & Co., Dusseldorf, Germany, for $25,000 worth of machine tools. It has also received a large order, amounting to $10,000, from the Volga Steel Works at St. Petersburg, Russia. The company reports its business as increasing very rapidly, and that business in the United States shows encouraging signs of improvement.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., has just issued the fifteenth edition of its handbook of electrical information. The work is very complete, and the matter contained will be of special value to all engaged in the electrical trades. A great deal of special information has been added to this book, and it is brought up to date in every particular. The book is issued in three styles of binding, and owing to its compact size it is especially convenient as a pocket handbook.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Iowa, reports an unusually large volume of trade for this Spring. Its well-known lightning arresters have established themselves in popularity, and now, with the advent of the thunder storm season, orders are pouring in with great rapidity. Despite the depression of which some concerns are complaining, this company is enjoying an almost surprising degree of prosperity, and its goods have now won such a foothold that they have come to be recognized as a standard in their class.

MESSRS. JAMES L. ROBERTSON & SONS, 204 Fulton Street, New York, describe and illustrate their various steam engine accessories in a neat catalogue just issued. The Robertson-Thompson steam engine indicator and its action are well presented and a description of the Hine eliminator, which gives general satisfaction to steam users, is also given a prominent place. This firm manufactures indicators, reducing wheels, planimeters, damper regulators, feed water heaters, and various other appliances necessary for the successful and economical operation of a steam plant.

GRAPHITE PAINT.—Most carefully conducted practical experiments with various pigments and oils, covering several years of time, have demonstrated that a properly made paint of graphite and boiled linseed oil is most useful for protecting structural iron work, roofs, etc., exposed to the destructive agencies of the weather. Dixon's silica graphite paint, which is manufactured by the Joseph Dixon Crucible Company, Jersey City, N. J., has during the past thirty years demonstrated the accuracy of this statement. Roofs and iron work properly painted with this paint have not required repainting in from fifteen to twenty years.

AN ELEGANT CATALOGUE.—The Allgemeine Elektricitats Gesellschaft, Berlin, Germany, has issued a very fine catalogue descriptive of its apparatus and several electric railways installed by that company in various European cities. Each installation is briefly described, and half-tone illustrations are presented showing electric cars, stations, etc., in the different cities. Maps of the routes of the different lines are also given in many cases, as are also plan views of some of the most important installations. The book is quite a work of art and is strongly bound in leatherette. In size it is 9 inches by 12 inches, and contains 331 pages.

LUNDELL FAN MOTORS.—The well-known Lundell fan motors, manufactured by the Interior Conduit & Insulation Company, New York, have been sold all over the world and the name "Lundell" has become synonymous with "Highest Standard of Merit." The company has placed upon the market this season several new styles of ceiling and column apparatus and its handsome illustrated catalogue shows a varied and complete line. The "Lundell" is not a cheap affair, but is a machine well made in every particular, handsome in design and finish, and is claimed to possess the highest obtainable efficiency. Illustrations of these fan motors are unnecessary for the reason that the general public, as well as the trade, are thoroughly familiar with their design and appearance.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 30, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

579,556. MULTIPLE-SERIES SYSTEM OF ELECTRICAL DISTRIBUTION; F. B. Badt, Chicago, Ill. App. filed Jan. 25, 1897. In a system of multiple-series distribution, the combination with main and compensating conductors, of an undivided source of electricity from which the main conductors are led, and means adapted to respond automatically upon a variation in potential between a compensating and a main conductor to reduce the electromotive force of the generator.

579,576. TROLLEY WHEEL FRAME FOR TROLLEY CARS; W. Grunow, Jr., Bridgeport, Conn. App. filed May 8, 1896. A tangible trolley-wheel frame which is connected with the trucks of a car, one end being pivotally connected therewith, and adapted to swing and the other end being also pivotally connected therewith, and provided with means whereby a slight sliding motion may be secured, said frame being also provided with trolley arms or levers pivotally connected with the bottom thereof, each of which is provided with a trolley-wheel, and with a vertical rod which passes through said frame, on each of which are mounted spring-regulating nuts, each rod being also provided with a strong spiral spring, which bears upon said nuts, and with a vertically-movable sleeve, which rests upon said springs and means for operating said devices.

579,582. ELECTRIC METER; G. Hookham, Birmingham, England. App. filed Sept. 18, 1896. In an electricity meter for continuous currents in which the motor-armature is immersed in mercury and rotates together with the brake in the field of a permanent magnet, in combination, the arrangement of the brake magnetic poles in parallel with the motor magnetic pole-pieces instead of in series, so that the magnetic polarities at the opposite sides of the rotating armature are opposite in kind; and the passage of the current across the armature from side to side, instead of from side to centre, to increase the driving force.

579,611. ELECTRIC HEATER; W. R. Smith, Manchester, N. H. App. filed June 11, 1895. In an electrical heating apparatus, an electrical resistance composed of a single jointless piece disposed in two helices of opposite pitch, one within the other.

579,633. TELEGRAPH TRANSMITTER; C. L. Buckingham, New York, and J. Gardam, Brooklyn, N. Y. App. filed Sept. 2, 1896. The combination, in a telegraph-transmitter, of a motor, a train of gear, circuit-controlling apparatus for directing suitable signals to line, a phonic governor consisting of a toothed wheel connected to and driven by said train of gear, and a tuning fork spring whose vibration is maintained by the teeth of said wheel.

579,634. PRINTING TELEGRAPH; C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y. App. filed Aug. 28, 1896. In a printing telegraph apparatus, a stationary tubular support, a sheet of paper formed into a tube having a row of holes perforated in the lap of said tube, an escapement-wheel, a spur-wheel meshing with said row of holes and a train of gearing for positively connecting the escapement and spur wheels together.

579,635. PRINTING TELEGRAPH; C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y. App. filed Sept. 3, 1896. In a printing machine, the combination of a stationary support, a paper tube, a step-by-step or escapement wheel, a train of gear, a feed wheel, a manual disconnecting apparatus, a cam, means for lowering said cam through said manual disconnecting apparatus, and means whereby said wheel may be raised or lowered.

579,636. PRINTING TELEGRAPH; C. L. Buckingham, New York and E. Germann, Brooklyn, N. Y. App. filed Jan. 5, 1897. In a printing telegraph, the combination of a message-blank formed into a paper tube, having a row of equidistant holes parallel with its axis, a tubular support having circumferential and diagonal grooves, a slot across said grooves lengthwise of the tube, a gear-train for rotating the paper tube, a motor for driving said train, an escapement therefor, means for disconnecting the escapement-wheel from its pallets, and a setting-arm which is moved within the teeth of the wheel, while the latter is in line with the slot and which is moved away from the teeth of said wheel when it is desired to insert a new message-blank.

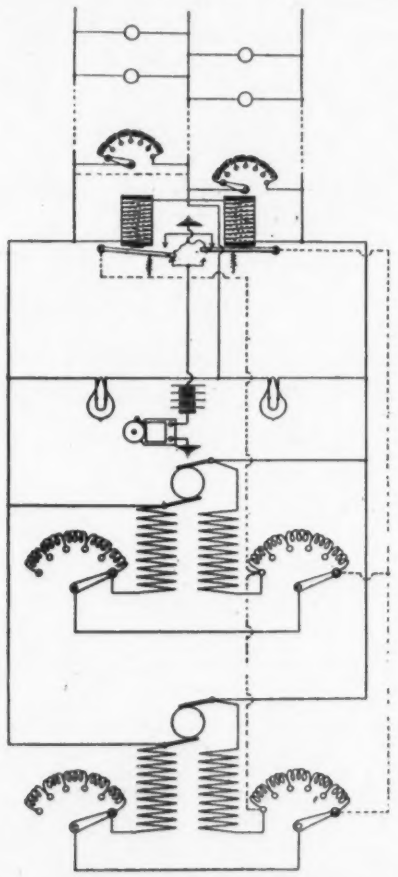
579,676. STOCK PRINTER; F. A. Graham, New York, N. Y. App. filed March 11, 1896. The combination of a single belt provided with printing-characters, of a series of paper strips, and electromagnetic mechanism for causing an impression to be made upon any one of the series of strips.

579,699. MICROPHONE; A. W. S. Davis, Lowell, Mass. App. filed April 30, 1896. In a microphone, the combination with a casing having a central aperture and a transverse groove, and a diaphragm, of a button, an adjusting-screw for the button, and a curved flat spring lying in the groove, for supporting the button.

579,707. ELECTRICAL GENERATOR; S. V. Essick, Yonkers, N. Y. App. filed May 14, 1896. As an electric generator, a single fluid cell comprising an external conducting vessel, an element of a more positive metal inserted therein, an electrolyte containing a salt of copper, a holder containing a supply of such salt of copper, means for feeding said salt to said electrolyte, as required, and means for externally heating the cell.

579,725. INSULATOR AND HOLDER FOR ELECTRIC RAILWAYS; W. C. Keithly, San Francisco, Cal. App. filed Nov. 27, 1896. An insulator and holder for electric railways, consisting of a metallic cap substantially of the form of a frustum of a cone, having lugs formed upon the interior, a correspondingly-shaped insulator with lugs formed upon the exterior, adapted to engage with those of the cap when the insulator is inserted and turned, whereby it is removably secured therein, means for suspending the cap from supporting-posts, and means for suspending the trolley-wire from the interior of the insulator.

579,728. TROLLEY SYSTEM. W. H. Walker, Pittsburg, Pa. App. filed June 26, 1896. In a trolley system, the combination of the trolley-head consisting of a bracket, wheels mounted therein and



No. 579,556.—Multiple Series System of Electrical Distribution.

adapted to contact with opposite sides of an overhead conductor, one of said wheels being mounted on a fixed axle and another being mounted on an axle movable in a slot in said bracket, a lever connected with said fixed and movable wheel-axles and adapted to press the movably mounted wheel away from the conductor, and means connecting the axles of the wheels for forcing the wheels into contact with the conductor.

579,759. ELECTRIC RAILWAY; F. Mansfield, New York, N. Y. App. filed Aug. 4, 1893. The combination of a car having double trucks, a contact device suspended therefrom and consisting of a short conducting-bar supported horizontally beneath the axles of each truck, and an intermediate conducting-bar hinged between said short bars.

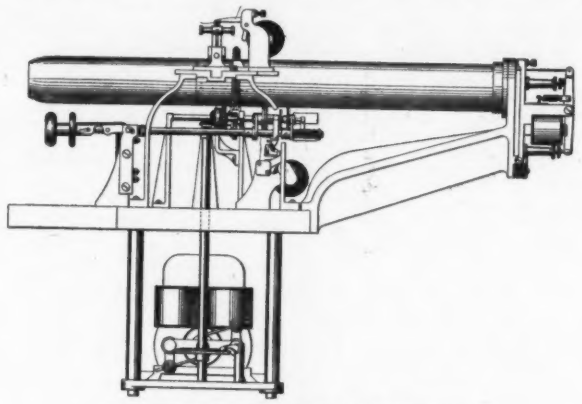
579,760. ELECTRIC RAILWAY; F. Mansfield, Philadelphia, Pa. App. filed Aug. 13, 1895. A car provided with a magnetic contact device carried a considerable distance above the ground for attracting and holding the circuit-completers in magnetic and electric contact therewith, and a set of magnets arranged at the end of said contact device for gradually raising the circuit-completers into contact with said contact device.

579,790. MOUTHPIECE FOR TELEPHONES; C. L. Cohn, Boston, and M. Martin, Malden, Mass. App. filed Dec. 11, 1896. A frusto-conical or cup-shaped mouthpiece-lining comprising a liquid proof external section, and an absorbant inner section secured to the interior of the outer section, and fastening devices for attachment to a correspondingly shaped mouthpiece.

579,808. REFLECTOR FOR FOCUSING CATHODE-RAYS; R. P. Russel, Birmingham, Ala. App. filed Sept. 15, 1896. As an improved article a focuser for X or cathode rays, consisting of an outer concavo-convex shell of lead or other inelastic metal, and an inner shell or lining of tin or other elastic metal.

579,864. SUBWAY JUNCTION BOX; G. C. Deake and G. N. Moore, New York, N. Y. App. filed June 30, 1896. The combination in a subway box, of an inner lower water-tight cover, a loose top cover, and a duplex gas relieve valve in the lower cover, said valve adapted to first open the vent into the valve chamber, and later open the vent from said chamber.

579,894. SWITCH-BOX FOR FLUSH SWITCHES; J. W. Poole, Chelsea, Mass. App. filed Dec. 28, 1895. A flush switch, consisting of a

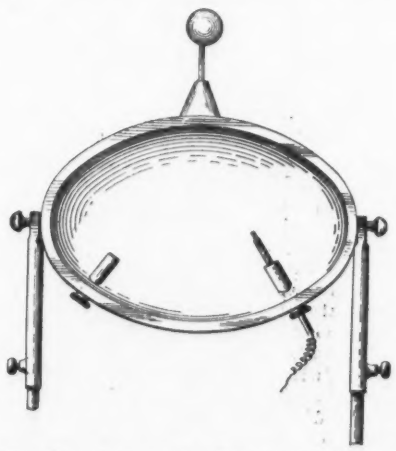


No. 579,634.—Printing Telegraph.

switch-box formed integral with a botton wall, having binding-posts provided with yielding electrodes, a switch-stem having a switch-bar, a cover-plate secured to the switch-box and formed at its centre with a concaved projecting cut through which the switch-stem extends, a face plate applied over the cover-plate provided with a central orifice into which the concaved cup of the cover-plate extends, and a handle secured to the switch-stem and projecting into the concavity of said projecting cup.

579,916. BATTERY COVER; H. J. Brewer, New York, N. Y. App. filed Oct. 2, 1896. A battery cover provided with an opening through which the upper portion of one element of the battery is adapted to pass, and a discontinuous closure fitting the said opening and the portion of the battery element passed through, the said closure being so constructed that it may be placed in position to close the opening around the battery element and support the same without passing the battery element through said closure.

579,929. ELECTRICALLY CONTROLLED RAILWAY SIGNAL; F. McBrien, Newark, N. J. App. filed Sept 3, 1896. A railway signal system comprising a track divided into a plurality of insulated sections, independent magnetically controlled signals at the same station operated by currents of different strengths in a controlling track-circuit common to both signals, circuit-controlling devices adapted to be actuated by a train for simultaneously actuating both signals when a train reaches the station, if the track ahead be clear, and



No. 579,808.—Reflector for Focusing Cathode Rays.

means for restoring them one at a time when the train reaches different determinate positions beyond the station by varying the current strength in the track-circuits.

579,933. SIGNALLING; J. G. Schreuder, Edgewood Park, and J. P. Coleman, Swissvale, Pa. App. filed Aug. 26, 1896. The combination of a signal, a track-lever, an electrically controlled connection between the signal and its lever, a circuit for said mechanism, an electrically controlled indicator, an operating magnet of said indicator being included in said circuit, a branch circuit including the armature of the indicator-magnet, a make-and-break mechanism controlled by train movements in the main circuit, and a second make-and-break mechanism in the main circuit and controlled by the signal-lever.